PHOSPHATE SLAG RISK

HEARING

BEFORE THE

SUBCOMMITTEE ON NUCLEAR REGULATION

OF THE

COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

AUGUST 21, 1990—SODA SPRINGS, IDAHO

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PHOSPHATE SLAG RISK

TUESDAY, AUGUST 21, 1990

U.S. SENATE,
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS,
SUBCOMMITTEE ON NUCLEAR REGULATION,
Soda Springs, ID.

The subcommittee met, pursuant to notice, at 10:12 a.m. in the Soda Springs High School Auditorium, 300 East 1st North, Soda Springs, ID. Hon. Steve Symms (acting chairman of the subcommittee) presiding.

Present: Senator Symms.

OPENING STATEMENT OF HON. STEVE SYMMS, U.S. SENATOR FROM THE STATE OF IDAHO

Senator **SYMMS**. Good morning, ladies and gentlemen. I wish to thank all of you who are here and those who have come considerable distances to make this hearing a success. I will have a brief opening statement and then we will touch on the format of this hearing. Then we will commence with the witnesses who will be seated at these tables on the side.

The Senate Environment and Public Works Committee, Subcommittee on Nuclear Regulation is now convened in Soda Springs, Idaho, on the 21st of August for the purpose of holding a hearing on phosphate slag risk communication.

Let me begin by thanking the chairman of that subcommittee, Bob Graham of Florida, and Senator Simpson of Wyoming, the ranking member, for approving this hearing. While it is not being convened in their respective States, the issues being discussed today will impact both the States of Wyoming and Florida, as well as here in Idaho.

The Chairman was unable to attend this hearing, but his staff assistant seated here, Mr. Dan Berkovitz, is present and will undoubtedly make a full report to the Chairman.

I hope that you enjoy a little bit of Idaho while you are here.

This young man here is Mr. Trent Clark, who is my staff assistant on the Environment and Public Works Committee, whose home is in—do you call it Teton or Rexburg now, Trent?

Mr. **CLARK**. I claim Victor.

Senator **SYMMS**. Victor, Idaho. Okay.

And as stated earlier, the topic is phosphate slag risk communication. Under this topic, the subcommittee hopes to gain information about the proper way for a regulatory agency to communicate and represent environmental risks that are present in a community, and to do it so that the community understands and accepts the risk message.

Furthermore, to illustrate the issue more clearly, this hearing focuses specifically on the risks posed by elemental phosphorus slag and the Environmental Protection Agency's recent release of the Idaho Radionuclide Study Fact Sheet and accompanying press release.

To begin the hearing I would like to make two observations.

One, it has come to my attention that some EPA officials have expressed concern over the fact that this hearing has been called at all. It was suggested that if this hearing somehow lessened the alarm and fear over slag radiation so that residents of the local community were unwilling to yield to EPA's demands, the agency would retaliate by considering Superfund listing for the entire community. I find such blackmailing of the congressional hearing process to be completely inappropriate.

Two, contrary to the rumored fears of EPA over the intentions of the hearing, this is not a "beat up EPA" session. The topic here is risk and how it should be communicated. EPA officials may correct me if I am wrong, but I understand that it is the agency policy that complete and adequate risk communication is supposed to be in the agency's best interests. A hearing to improve risk communication should therefore be seen as an opportunity by the agency and by all of us involved, and not an obstacle.

In order to have orderly presentation of the testimony, it requires a few rules. The witnesses will be called to the front panel by panel, and it would be appreciated if the witnesses could move quickly and quietly to one table or the other in front. There is one microphone. We will have to pass that back and forth among the panelists. That will make it much easier for all those in the room to hear and for our reporter to record the hearing testimony.

Each witness has been allotted an amount of time for oral presentation. Trent will hold up the orange card when you have a minute left, to warn you, and the red card when your time has expired.

I would like to try to stick to the time as best as is possible, but I do know that many witnesses have come here from quite some distance, and I would really like to have people be able to say what it is that's on their minds and make their point. So I might just say that we'll do the best we can on this. It is my hope that out of this hearing will come a conclusion that we can have a better attitude of cooperation between the Government of the United States and the people that Government represents and is supposed to be in business to serve and take care of, and that we can have a cooperative attitude between the Government and the people rather than an adversarial role, which I think becomes self-defeating. When regulatory agencies become adversarial with the people they are supposed to help, I think it does nothing for the environment or for the good or the order of this great land of ours.

The first witness today was to be my senior colleague in the Senate, Senator McClure. Unfortunately he couldn't be present, but we do have the pleasure of having his statement presented by his capable staff assistant from Pocatello, Valerie Watkins.

Before I call on Valerie I would like to state for the record that Congressman Craig and Congressman Stallings also have statements that are submitted to the record. I now order those items to be placed in the record at the appropriate place.

[The statements of Messrs. Craig and Stallings follow:]

Statement of Congressman Larry E. Craig
before
U.S. Senate
Environment and Public Works Committee
Soda Springs, Idaho
August 21, 1990

THE PROTECTION OF PUBLIC HEALTH IS THE MOST IMPORTANT CHALLENGE THAT ANY PUBLIC AGENCY OR PUBLIC OFFICIAL CAN CONSIDER. THE QUESTION OF THE PRESENCE OF RADIOACTIVITY IN THE COMMUNITIES OF POCATELLO AND SODA SPRINGS IS OF THE UTMOST CONCERN TO ALL OF US. WE MUST THOROUGHLY UNDERSTAND THE LEVEL OF RISK AND THE CURRENT THREAT PRESENTED FROM SLAG CREATED BY THE PHOSPHORUS INDUSTRY. THE LEVEL OF RISK AND ITS RELATIONSHIP TO OTHER SOURCES OF RADIOACTIVITY, SUCH AS BACKGROUND LEVELS, MUST BE CONSIDERED AND THE LEVEL OF RISK TO CITIZENS OF POCATELLO AND SODA SPRINGS WEIGHED AGAINST THIS INFORMATION.

THE ENVIRONMENTAL PROTECTION AGENCY HAS PUBLISHED A STUDY THAT THE AGENCY CLAIMS IS AN ACCURATE SCIENTIFIC ESTIMATE OF THE LEVEL OF RISK THAT THE CITIZENS OF POCATELLO AND SODA SPRINGS MUST CONFRONT AS A RESULT OF THE DISPOSAL OF SLAG. TODAY THIS COMMITTEE WILL EVALUATE THE RECOMMENDATIONS OF THE EPA AND HEAR TESTIMONY FROM

CITIZENS, INDUSTRY REPRESENTATIVES AND AGENCIES THAT ARE AFFECTED BY THE FINDINGS OF THIS REPORT. THE COMMITTEE WILL LEAVE NO STONE UNTURNED IN EVALUATING THE SUBSTANCE OF THE EPA REPORT AND THE THREAT THAT RADIONUCLIDES PRESENT TO THE COMMUNITIES. I COMMEND THE CHAIRMAN AND SENATOR SYMMS FOR BRINGING THE COMMITTEE HERE TO SODA SPRINGS TO INVESTIGATE THIS ISSUE THAT IS FOREMOST IN ALL OF OUR MINDS.

WHEN THIS COMMITTEE HAS COMPLETED ITS FINDINGS, I WILL WORK TO ASSURE THE PUBLIC WELFARE IS ADDRESSED AND PROTECTED AT A LEVEL THAT SAFEGUARDS BOTH PUBLIC HEALTH AND COMMUNITY ECONOMIC VIABILITY.

THANK YOU, MR. CHAIRMAN.

RICHARD H. STALLINGS
2d DISTRICT, IDAHO

1221 LONGWORTH BUILDING
WASHINGTON, DC 20515
(202) 225-5531

COMMITTEE ON
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Congreſs of the United States
House of Representatives
Washington, DC 20515

August 21, 1990

The Honorable Steve Symms
Committee on Environment and
Public Works
United States Senate
Hart Building, Room 509
Washington, D.C. 20510

Dear Steve:

I wish I could join you today to discuss the recent Idaho Radionuclide Study and its impact on Southeast Idaho. I am hopeful today's hearing will help foster a better understanding of the issue and provide answers to many of the questions people have raised.

As you know, the Environmental Protection Agency study found that radioactive phosphorous slag poses a significant health risk to the citizens of Soda Springs and Pocatello. The public release of the federal study has caused considerable interest and concern among local residents and company officials in the two areas.

The study also raised several questions regarding the scientific analysis by the EPA. One of my major concerns is that the Idaho Radionuclide Study and future testing be on a solid scientific and technical basis.

I agree that if slag presents a public health risk, its use should be discontinued. However, considering the potential impact these findings will have on public health concerns and the economic well-being of these two communities, a complete analysis is essential to ensure the survey was done using sound procedures.

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Questions also have been raised as to the EPA's choice of Southeast Idaho as an area of review. It is my understanding that phosphorus slag has been utilized for the same purposes in Montana, Tennessee, and Florida.

In a recent letter to EPA Administrator William Reilly, I expressed my concerns regarding the slag study and asked the agency to respond to several specific issues. Additionally, I asked Mr. Reilly to submit the study and analysis to the agency's Science Advisory Board for review and approval.

I believe EPA officials can do a better job when informing the public about potential environmental risks, such as those posed by phosphorous slag. The agency must make a stronger commitment to educate and involve local citizens on decisions regarding slag-associated radiation risks in Southeast Idaho.

In closing, I would ask that the Committee keep open the hearing record for thirty days in order to accept additional written comments from the public. I look forward to working with you on a final resolution of this issue.

Sincerely,

RICHARD H. STALLINGS
Member of Congress

RHS: cj

Senator **Symms**. Valerie, welcome to the committee. You may proceed.

STATEMENT OF HON. JAMES A. McCLURE, U.S. SENATOR FROM THE STATE OF IDAHO, PRESENTED BY VALERIE WATKINS, STAFF ASSISTANT

Ms. **Watkins** [reading].

Regarding phosphate slag risk communication and regulation, Mr. Chairman, I appreciate this opportunity to offer my thoughts about the process of regulating phosphate slag waste in eastern Idaho.

Mr. Chairman, our laws give a great deal of responsibility to the Administrator of the United States Environmental Protection Agency, EPA, so that our health and the health of our planet may be maintained and strengthened. Our Superfund law allows the Administration to declare a substance hazardous if it poses substantial danger to the public health or welfare, or the environment.

The law also gives the Administrator a lot of latitude to decide what to do about this threat. He may remove it, or take any other response measure deemed necessary.

The Administrator must consider the risks to physical health and the environment. Our environmental laws generally do not require a balance with economics or jobs. There is no required accounting of the things that mean so much to many of us, things for which we have worked and which mark our progress through life.

It is to the Administrator's credit that EPA often does consider such a balance and tempers its decisions accordingly.

There must be a temptation, when dealing with the purity of our earth, to disdain compromise. After all, the agency's technicians understand the science better than most of us possibly could. It must be difficult when we do not accept what the experts tell us for our own good. But yielding to such temptation exaggerates the imbalance inherent in our laws.

Nearly three months ago in this case an EPA field officer was quoted in an Idaho news article. He reportedly said that since the communities did not react to earlier statements about slag as EPA wished, the agency decided on a stronger strategy of persuasion. It was a strategy of threats and stronger regulations. It was designed to make our communities and their industries aware of the scope of the danger which EPA sees here in eastern Idaho.

When EPA sent its Superfund staff to announce the Idaho Radionuclide Study, the implication was not lost on us. Idaho has several Priorities List Superfund sites, and we well understand the stigma that surrounds them. That announcement made our communities aware that they were left to suffer the consequences of confusion.

EPA now says that the Idaho Radionuclide Study will lead to a thorough examination of actual exposure and risks. It is worthwhile to ask why that was not done in the first place and made a part of the original study before its release.

There is danger that the interim confusion may close some small businesses which make a living by utilizing phosphate manufacturing byproducts. That would create more waste for expensive and useless discard instead of being put to productive use.

I am deeply concerned about the possibility of any health risk from the use of phosphate slag. I am concerned about the confusion and polarization which now abides in these communities. I am absolutely committed to working with EPA and with our communities to eliminate the fear and to take whatever action we must to abate real danger to the health of our citizens.

I ask EPA to work hard in Soda Springs and in Pocatello to explain, enlighten, and to help put an end to the disruption. EPA's role is key. First, the Administrator should remove the threat of Superfund National Priority Listing of these communities quickly, efficiently, and completely. Second, we need to know about the risk assessment in this case. We need clear explanation of the assumptions made at every stage of development of the model. Assumptions are part of every risk assessment process, and this one surely has its share. No doubt the process is complex, but it can be explained.

Third, EPA should make every effort to keep the communities completely informed of the progress of the next study phase and to explain its findings.

For our part, the citizens of Pocatello and Soda Springs should cooperate with EPA and listen calmly and well to what the agency tells us. We need EPA here if the risk is as claimed. We need the agency's expert guidance and recommendations. Then we must make reasoned decisions for our health and for the health of our children. We must make responsible decisions. Government agencies ought not to have to try to protect us from ourselves.

Throughout this process others will be watching. People all across the country are watching situations like this one and they are forming opinions about how well our environmental protection mechanisms work in the real world. New Age philosophers speak of holistic approaches to our problems. Mr. Chairman, that is supposed to be an enlightened way of thinking, emphasizing the importance of the whole and the interdependence of its parts. Holistic protection for our environment will balance physical with fiscal health and will not force us back to caves and trees but will allow us the freedom to progress, which we must have as human beings.

Thank you, Mr. Chairman.

Senator SYMMS. Thank you very much, Valerie, for an excellent statement on behalf of Senator McClure.

I don't think I have any questions at the present time, so we'll ask panel one to please come up. That's Henry Schilling, Director of the Office of Pollution Prevention, Environmental Protection Agency; Richard Schultz, Administrator, Division of Health, Idaho Department of Health and Welfare; Charles Findley, Director, Hazardous Waste Division of the Environmental Protection Agency; and Mr. John Horan, former Chief, Radiological Safety Division, International Atomic Energy Agency.

If the next panel would want to get into position, it might make it a little easier: Mayor Angstadt of Pocatello; the Honorable Bob Geddes, Idaho House of Representatives; Kirk Hansen, Mayor of Soda Springs; the Honorable Denton Darrington of the Idaho State Senate; and Tom Katsilometes, Bannock County Commissioner.

Gentlemen, we will start off with Mr. Schilling. As the first witness.

STATEMENT OF A. HENRY SCHILLING, DIRECTOR, OFFICE OF POLLUTION PREVENTION, ENVIRONMENTAL PROTECTION AGENCY, ACCOMPANIED BY ADM. RICHARD J. GUIMOND, U.S. PUBLIC HEALTH SERVICE, DIRECTOR, OFFICE OF RADIATION PROGRAMS, ENVIRONMENTAL PROTECTION AGENCY

Mr. SCHILLING. Thank you, Senator. Also accompanying Chuck Findley and me is Assistant Surgeon General, Admiral Richard Guimond. He is a U.S. Public Health Service officer and is Director of EPA's Office of Radiation Programs. He's here to answer any questions that might arise about the technical work and science in the Idaho Radionuclide Study.

It is a pleasure to be here in Idaho. For anybody living inside the Beltway, it's a great treat to have an excuse to get to the Northwest in the summertime. It is nice for me to come back to the Northwest.

I want to talk briefly about risk communication. I have a statement for the record and my remarks today will be drawn basically from that statement.

Risk communication is the exchange of information about hazards. All three elements are important; that is, exchange, information, and hazards. It is, as you noted, Senator, essential to EPA's view of how to carry out its mission of protecting human health and the environment. In fact, risk communication gets more important as we move to deal with problems which require actions by individuals, often large numbers of individuals, as opposed to our more historic role of regulating industry. An example of such problems is radon in people's homes, obviously.

This new age of cooperative solutions to environmental problems depends heavily on risk communication, properly understood, and yet it is a fairly difficult business, in part because the essence of risk communication at some level is communicating bad news to someone. Hence, we have a dilemma in risk communication. To paraphrase Administrator Reilly, the dilemma is threading a way through the problem of boring the public to death when we talk about risk, often in scientific terms, or scaring them to death when we talk about risk. Somehow, we need to set a balance so the public can hear and take appropriate action.

A consequence of this dilemma, to quote my boss, Jerry Davies, is that the risk communication process is very often unsatisfactory for everybody involved. He said that in 1986. Unfortunately it is still generally true today, and I am aware that it is particularly true here today, which is one of the reasons we are here. Obviously, there is dissatisfaction and concern with how EPA has handled the risk communication process about phosphate slag risk to date.

Let me talk generally for a bit about how EPA is moving to resolve this dilemma and the resulting dissatisfaction.

Beginning in 1986 we have embarked on a program of risk communication research. It started with a national conference on risk communication in 1986. It has led, among other things, to development of a workshop on risk communication which is being increasingly used as a staff training device. We're trying to teach ourselves how to do it as best we understand it.

Over the course of this research and related work we have evolved a broad approach to risk communication embodied in a document called, "The Seven Cardinal Rules of Risk Communication." I will just run through these seven rules briefly. They have a common-sense ring to them, but their application in practice often takes a great deal more than common sense.

First, accept and involve the public as a legitimate partner.

Second, plan carefully and evaluate the results of risk communication activities.

Third, listen to and understand the public's specific concerns.

Fourth, be honest, frank, and open.

Fifth, coordinate and collaborate with other credible sources of information.

Seventh, speak clearly and with compassion.

These seven rules are really more a set of maxims aimed at individual communicators within the agency and elsewhere. How they fit in a particular situation depends on the circumstances. Risk communication, in our view, remains at least as much art as engineering. While we are making progress in understanding scientifically how people think about and understand risk—and therefore, how best to address the communication needs—the keys to success over the near future are going to remain the skill and concerns of risk communicators rather than the application of rules, procedures, and other aspects of bureaucratic process.

A local note on that point. If it weren't for the personal skill in communications, all of the EPA contingent here today would probably still be wandering around town, reading street signs for the many intersections of Soda Springs' 3rd Streets and 1st Streets. Instead of reading the signs, we chose to ask somebody in a yard and got good information. Successful communication, at root, is a personal process.

Let me close with the hope that we can use today's discussions and the concerns that underlie them to improve the communications process as we continue work on the risks from phosphate slag in this community and in Pocatello, particularly as we move to decisions about how best to manage those risks.

While Region X will have the lead role for EPA in this work, the Policy Office is willing and available to do whatever it can to be helpful as we go forward.

Thank you.

Senator SYMMS. Thank you very much, Henry.

I might say to the audience that Mr. Schilling has from EPA headquarters in Washington, D.C. At the head of that office is Assistant Administrator Terry Davis, who is a nationally-recognized author and lecturer on the topic. I know that Henry is very well versed on it, as you can tell from his testimony.

We appreciate your being here.

The next witness is Charles Findley, who is the Director of the Hazardous Waste Division of EPA from Region X.

Charles.

STATEMENT OF CHARLES E. FINDLEY, DIRECTOR, HAZARDOUS WASTE DIVISION, REGION X, ENVIRONMENTAL PROTECTION AGENCY

Mr. FINDLEY. Senator, I will keep my remarks brief.

Senator SYMMS. I might say for the record that all statements will appear in the record in full, so that the committee will have the benefit of the statements in Washington. Thank you.

Mr. FINDLEY. I'd just like to take the opportunity today to describe briefly EPA's future plans for the Idaho Radionuclide Study.

We are seeking the help of State and local authorities and the community in developing plans for minimizing risks associated with slag exposure. Our biggest concern in the near term is to reduce the exposure to those individuals who currently are at most risk. Those are people who are living in homes with slag foundations.

Before we initiate either the additional home testing that we intend to do, or undertake any remedial actions, we will share our plans with the public and we will ask for your input. We are in the process of developing a proposed sampling plan for the voluntary radiation testing of homes in Soda Springs right now.

We are also identifying options for establishing action levels. The action levels that we finally select will be radiation levels for residential homes, above which we would recommend that some type of corrective action be taken.

A formal public comment period will precede EPA's decisions on a final home testing plan and action level. To put it very simply, we want community input at this juncture and we want it from this point forward. EPA plans to involve the community in determining a long-term course of action for slag in streets and sidewalks, the other part of the problem that we're looking at. Currently, specific recommendations concerning the need for road or sidewalk remediation have not been made.

We strongly support the voluntary steps taken by Monsanto and FMC to curtail and to stop slag sales at this point.

I would just observe that if remedial action is necessary for roads and sidewalks, that it could probably be done over a much longer period of time—say, 15 to 20 years—and probably could be accomplished as a part of normal road maintenance. We think this is a part of the problem that can be solved fairly easily.

I want to assure you that EPA will be open and responsive to the people of southeastern Idaho. We will continue to share our information with you and will listen to your concerns. As we conduct additional sampling and move forward with decisions, we will do everything possible to ensure that our science is sound and that the materials that we present are accurate and complete. We will certainly give the public the opportunity to participate in the decision-making process at key points in a meaningful way.

In conclusion, I would ask that we all work together to develop a plan for remediating whatever has to be done to protect the health and the prosperity of these communities.

Thank you, Senator, for the opportunity to testify.

Senator SYMMS. Thank you.

Our next witness is Mr. Richard Schultz, who is the Administrator of the Division of Health of the Idaho Department of Health and Welfare.

Richard.

STATEMENT OF RICHARD H. SCHULTZ, ADMINISTRATOR, DIVISION OF HEALTH, DEPARTMENT OF HEALTH AND WELFARE, STATE OF IDAHO

Mr. SCHULTZ. Thank you, Senator. It is my pleasure to be here today representing the Department, as the Director, Mr. Donovan, is attending a Board of Health and Welfare meeting in northern Idaho.

The Department of Health and Welfare in the mid-1980s, under the direction of Mrs. Rose Bowman, chose not to be formally involved in the design or the conduct of the EPA study of radionuclides in Pocatello and Soda Springs. However, when EPA was preparing to release the preliminary results in March of 1989, they contacted the State to inform us of the preliminary findings and to determine what role, if any, the new administration wished to play in communicating the results. An executive summary of the results was provided to the State at that time with the caveat that the results were primarily those of EPA's contractor, Battelle Pacific Northwest Labs, and that they had "not received complete agency review and thus should be considered draft and subject to revision."

It was determined that the most appropriate role for the State would be to accompany EPA to the communities and assist the communities in placing the risk estimates in perspective, and offer whatever technical assistance the communities may desire pending finalization of the study results. In that role, Mr. Joe Nagle, Administrator of the Division of Environmental Quality, and I met with EPA and local officials of Soda Springs and Pocatello on June 15 and 16, 1989. No requests by local officials for technical assistance from the State resulted from those meetings.

This past May, the State was informed by EPA that the study results were final. We were again invited to participate in release of the information to local officials and the public. The State was provided copies of EPA 526-90-008, Idaho Radionuclide Study. There were only minor changes from the summary data that the EPA had provided the previous year.

Based on the assumption that the results were scientifically valid and that the levels of risk from slag were magnitudes higher than other EPA-regulated environmental risks, the Department committed to playing a more active, yet undefined, role in assisting the affected communities in addressing the issue of health risk.

I participated in EPA's public meetings in Soda Springs and Pocatello on June 18 and 19, 1990, to listen to the dialogue between EPA and the communities and to respond to any questions specifically addressed to the State. Following these public meetings the Governor was informed by industry officials that the Radionuclide Study results had not undergone review by the Science Advisory Board. This was later confirmed by EPA.

Given the controversy surrounding quantification of health risks as a result of exposure to low levels of radiation, the Governor has suggested in writing to the Administrator of the EPA that the study be submitted to the Science Advisory Board to ensure that the study is technically and scientifically sound.

He has also requested that data be provided to the State and the public in sufficient detail to allow State officials to develop a sound, scientific framework concerning the issue. EPA staff, industry representatives, and State officials met August 9, 1990. EPA committed to provide on request to industry and the State copies of data collected during the course of the study that would not breach homeowner confidentiality. They also proposed establishing action levels for radiation resulting from the use of slag in home construction. The establishment of these levels would be followed by the proposed home sampling plan, which would be provided for public review and input prior to implementation.

Finally, EPA agreed to establish time frames for determining the level of health risk associated with areas surfaced with slag.

The State stands ready to work with industry, the communities, and EPA to reduce the health risks to individuals in Soda Springs and Pocatello when information is available to identify the parameters of such action.

Thank you, Senator.

Senator SYMMS. Thank you, Richard.

It is a pleasure for me to introduce the next witness, Mr. John Horan. John is a certified health physicist and accident investigator with over 40 years' experience. He has worked for 14 years as Director of Health and Safety for the U.S. Atomic Energy Commission, Idaho Operations. On loan to the International Atomic Energy Agency, he served as Chief of the Radiological Safety Group. He was Chairman of the Radiation Protection Committee for five years and represented the agency on the International

Commission on Radiation Protection, the U.N.'s Scientific Committee on Effects of Atomic Radiation, and the Public Health Committee of the Nuclear Energy Agency.

It should be noted for the record that John is now retired from Federal service but is still actively involved in consulting. Among his clients are Monsanto. That, however, is not the capacity in which he is testifying today, but rather as an internationally-recognized authority on radiation risk and the former head of one of the world's foremost radiation risk regulatory entities.

John, welcome to the committee this morning.

STATEMENT OF JOHN P. HORAN, FORMER CHIEF, RADIOLOGICAL SAFETY DIVISION, INTERNATIONAL ATOMIC ENERGY AGENCY

Mr. HORAN. Thank you very much, Mr. Chairman.

First I would like to express my appreciation for the invitation to present information on how the risks involved in the use of phosphate slag should be understood and communicated.

Mr. Chairman, I would like, as you have mentioned, to be what the legal system calls "a friend of the court" to present information on the basic findings which are behind the standards and regulations in the field of radiation protection. I shall confine my remarks to an international overview of low-level radiation exposure to the public.

Over the past 40 years, no other scientific issue has aroused so much public controversy as the biological effects of ionizing radiation. The estimation of cancer risk at low levels of radiation dose may always remain a controversial issue. It is so complex, it may never be deciphered. Many leading scientists believe that it may be far beyond our knowledge in medicine, biology, chemistry, physics, and computer sciences.

Two major factors which complicate this search for realistic solutions are, first, that natural background radiation is found in every aspect of God's creation, from cells to stars.

Second, natural radiation is theoretically responsible for less than one out of every two hundred cancers.

The difficult task of estimating the cancer risk from low-level radiation is the responsibility of three prestigious organizations: the United Nations Scientific Committee on Effects of Atomic Radiation, commonly called "UNSCEAR," which has been functioning since 1955; the International Commission on Radiological Protection, ICRP, which has been active since 1928; and finally, the National Committee on Radiation Protection and Measurements, NCRP, which has been operating since 1921 under a different name, but it has a Congressional charter since 1964.

These groups are composed of highly respected scientists from around the world. They study all available experimental data, technical reports, and statistical studies. Their conclusions and recommendations are widely accepted by organizations charged with regulating radiation throughout the world.

Briefly, the essence of their most recent reports as they apply to this hearing is the following consensus findings and recommendations.

First, the human race has been exposed to natural radiation levels of more than 300 millirem per year, and that is including radon, since the beginning of time.

Second, high levels of radiation exposure produce measurable biological effects. These are observed at acute doses greater than 10,000 millirem.

Third, the major health effect associated with radiation exposure is an increased risk of developing cancer, primarily leukemia.

Fourth, exposure to low-level radiation is an insignificant hazard to human health. Low-level is defined as background exposure levels below 500 millirem per year.

Fifth, for low-level exposure, the lower limit in radiation risk estimates may extend to zero.

Sixth, to be conservative, it is assumed that any dose from ionizing radiation, no matter how small, has some health risk. A single radioactive particle can cause a cancer by injuring a single cell. However, the probability is so small we cannot even visualize it: one chance in about 50 quadrillion. That's 5 with 16 zeroes after it.

Seventh, unnecessary radiation exposure should be kept as low as reasonably achievable, taking into account economic and social aspects.

Eighth, radiation protection of the general public should be limited to levels comparable to commonly accepted risks experienced in daily living.

That's from NCRP No. 91.

In conclusion, Senator, man has been involuntarily exposed to low levels of radiation from his environment since the beginning of time. This has caused a hypothetical but very low degree of risk to cancer which cannot be quantified. Today, with greater knowledge of other hazards throughout our environment, radiation protection should be limited to reasonable regulatory activities which have, as their goal, a balance between the needs of society, the benefits gained, and economic factors.

Thank you, Mr. Chairman.

Senator SYMMS. Thank you very much for your statement.

I have a few questions for each of you that I would like to ask, if I could go through those.

Senator SYMMS. This is for Mr. Findley and Mr. Schilling.

It is my understanding that both EPA and the National Academy of Sciences have issued guidelines for adequate risk communication. Is that correct?

Mr. SCHILLING. Let me start on this, and then Chuck can add to it.

EPA has developed a sort of rough maxim called "The Seven Cardinal Rules of Risk Communication," which I summarized in my remarks. The National Academy of Sciences has published a report that lays out a set of guidelines for risk communication.

Senator SYMMS. So that's basically correct?

Mr. SCHILLING. Yes.

Senator SYMMS. Is it the EPA's position that risk communication which is slightly less than adequate is nevertheless acceptable?

Mr. SCHILLING. I think a fundamental problem with risk communication is—again, as I noted, it is more art than engineering; it involves what is often the conveyance of bad news. Given those two factors, there will always be some dissatisfaction around our efforts to do it.

We do not yet have, I believe, a clear enough scientifically grounded understanding to be able to say with great precision what is or what is not adequate. It is ultimately in the eye of the beholder, like beauty; that is, the measure of adequate risk communication is whether or not the message gets through and the people involved are able to take the appropriate action.

Senator SYMMS. You quoted this earlier, that Administrator Davies has stated that "the failures in risk communication corrode the fundamental trust necessary for a democratic government." Assuming that EPA does not want to corrode that democratic government, shouldn't every effort be made on the agency's part to assure that risk communication meets at least the established minimum criteria for adequacy?

Mr. SCHILLING. I think it's important that we make every effort to make sure that risk communication works. I have some questions yet about how well we can define specific criteria. I know our own Seven Cardinal Rules are really guidance to be applied with intelligence, I hope, and flexibility and imagination in the circumstances. I am less clear, because less familiar, with the NAS guidelines and how specifically binding and useful they might be. We have no decision as an agency on them yet.

Senator SYMMS. Well, thank you.

On June 19th I submitted a letter to the Administrator of EPA detailing the National Academy and EPA minimum risk communication criteria, which appeared to be lacking in the phosphate slag information released to approximately 120,000 citizens of Idaho on May 13th, 1990. I would like to insert that letter in the record at this point.

[The letter referred to follows:]

QUENTIN N BURDICK NORTH DAKOTA CHAIRMAN
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MAX BAUCUS MONTANA
FRANK R LAUTENBERG NEW JERSEY
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JOHN H CHAFEE RHODE ISLAND
ALAN K SIMPSON WYOMING
STEVE SYMMS IDAHO
DAVE DURENBERGER MINNESOTA
JOHN W WARNER VIRGINIA
JAMES M JEFFORDS VERMONT
GORDON J HUMPHREY NEW HAMPSHIRE
DAVID M STRAUSS STAFF DIRECTOR
ROBERT F HURLEY MINORITY STAFF DIRECTOR

United States Senate
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
WASHINGTON, DC 20510-6175

June 19, 1990

The Honorable William K. Reilly, Admin.
U.S. Environmental Protection Agency
401 "M" Street, S.W.
Washington, D.C. 20460

Dear Bill:

Last month, the EPA issued a press release and "Fact Sheet" declaring that "phosphate slag" in building materials in Pocatello and Soda Springs, Idaho, "constitutes a definite health problem." The "Fact Sheet" cited a cancer risk to the "maximally exposed individual" as high as one in one hundred sixty-seven.

I am writing to express concern with the nature of the Agency's risk communication on this matter. Certainly you agree that risk communication is not an EPA responsibility to be taken lightly. Over half a decade ago, the Council on Environmental Quality affirmed that "an improved national environmental program depends absolutely on improving the way we discuss and communicate risk."1/ Your own Assistant for Policy, Mr. J. Clarence Davies, has spoken widely on this point, asserting that:

> Failures in risk communication . . . undermine attempts to deal rationally with risk, corroding the fundamental trust necessary for democratic government. Simple analyses, simple solutions, simple explanations, whether in laboratories or newspapers, are almost certain to be wrong.2/

A large number of publications and scholarly articles have recently addressed the communication of environmental risk, including the Agency's own "Seven Cardinal Rules of Risk Communication."3/ After reviewing the EPA materials distributed in connection with this May "phosphate slag" news release,

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1/ Council on Environmental Quality, Environmental Quality 1985, p. 24 [emphasis supplied].

2/ J. Clarence Davies, "Understanding and Communicating Risk", as presented to the Council of Chemical Research, October 10, 1985.

3/ Vincent T. Covello and Frederick W. Allen, "Seven Cardinal Rules of Risk Communication", pamphlet published by the Environmental Protection Agency, OPA-87-020, 1988.

I fear that Mr. Davies' comment may well apply -- the risk communication is so inadequate when judged by accepted scientific standards, and the Agency's own guidelines, that it is "almost certain to be wrong."

In October of 1989, the National Research Council of the National Academy of Sciences issued a report providing substantial guidance on proper risk communication.4/ That report details a 28-point "Risk Message Checklist" deemed necessary to "ensure that the messages are complete", specifically suggesting that "there are major advantages in putting the information into written form."5/ The EPA "phosphate slag" materials distributed to the public failed to include 27 of the 28 points on that checklist, as demonstrated by the enclosed side-by-side comparison. Note that the EPA's released material was completely silent on entire subject areas, such as benefits and alternatives, deemed by the National Academy to be essential to proper risk communication.

Furthermore, the "slag" release and "Fact Sheet" fall short of even the EPA's own guidelines.6/ Consider the following specific examples:

Public Involvement (EPA Rule #1)

The EPA guidance clearly states, "Involve the community early. . .Involve all parties that have an interest or a stake in the issue under consideration." And yet, it is fair to say the EPA "Slag Report" caught affected municipal governments, the Congressional delegation, and impacted businesses completely by surprise. Public input was sought only after the release was made.

Provide the Strengths and Weaknesses of the Information (EPA Rule #2)

In commenting on EPA's proposed Cancer Risk Assessment Guidelines, the White House Office of Science and Technology Policy noted that "quantification of the various sources of uncertainty can be as important as the estimate itself," noting further that failure to do so would be "misleading and spurious" because "it leads to a burial of the uncertainty in the estimates."7/

And yet EPA's "slag" material contained only two qualifying statements about the estimated risk: (1) it might be high because of old data, and (2) it

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4/ National Research Council, Committee on Risk Perception and Communication, Improving Risk Communication, National Academy Press, 1989, 332 pp.

5/ National Research Council, Improving Risk Communication, p. 174.

6/ Covello and Allen, "Seven Cardinal Rules of Risk Communication".

7/ Office of Science and Technology Policy, Comments on EPA Proposed Guidelines for Carcinogenic Risk Assessment, (July 15, 1986), p. 6.

might be low because of new risk factors contained in the BEIR V report. This falls far short of the guidance contained in EPA's own "Guidelines for Carcinogen Risk Assessment", which state: "The range of risks, defined by the upper limit given by the chosen model and the lower limit which may be as low as zero, should be explicitly stated."8/ Furthermore, the National Science Foundation has recommended that risk analysis "contain a full disclosure of the range of data so that relative uncertainty can be assessed."9/ As former EPA Administrator William Ruckelshaus noted:

> We must expose to public scrutiny the assumptions that underlie our analysis and management of risk. If we have made a series of conservative assumptions within the risk assessment, so that it represents an upper bound estimate of risk, we should try to communicate this and explain why we did it.10/

There is no doubt that undisclosed "assumptions" abound in the EPA study. In fact, the structure of the study itself, a hypothetical dose-incidence model, has been called a "gross oversimplification" by credible sources within the scientific community.11/ The decision to use this model itself is open to legitimate question.

Distinguish Between Scientific and Policy Determinations (EPA Rule #3)

Again, EPA's guidance states, "Do not make assumptions about what people want done about risks." The "Idaho Radionuclide Study" is an assessment of risk, not a policy paper addressing correction of that risk. And yet in the EPA release, the Agency ventures the advice that "the future use of slag in roads and construction should be banned." This advice may or may not be sound, but that question is not answered merely by release of the risk assessment. It is precisely this kind of "jumping from assessment to management" that the National Research Council decried as a "blurring of the distinction between scientific

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8/ "Guidelines for Carcinogen Risk Assessment, 51 Fed Reg 33992, (September 24, 1986).

9/ Letter for David Kingsbury, Asst. Director, National Science Foundation, to James Kamihachi of OMB's Office of Information and Regulatory Affairs, July 25, 1986.

10/ William D. Ruckelshaus, "Risk in a Free Society", Environmental Law Reporter, 14 ELR 10190, reprinted from a speech at Princeton University on February 18, 1984.

11/ Arthur C. Upton, "The Biological Effects of Low-Level Ionizing Radiation", Scientific American, Volume 256, No. 2, 1982, p. 47.

and policy judgments."12/

Discuss Data by Other Credible Sources (EPA Rule #4)

EPA's press release was not made in a vacuum of information about radionuclides in Eastern Idaho. Other credible sources have studied the issue and arrived at differing conclusions, including Monsanto's radiation exposure readings, and the studies of Dr. Sidney Shindell of the Department of Preventive Medicine at the Medical College of Wisconsin. Nothing in EPA's materials mentions, much less "discusses" the disparity between these different studies.

Use Non-Technical Language (EPA Rule #7)

I am particularly concerned by the EPA's use of the "maximally exposed individual" (MEI) without any explanation of the highly technical nature of that term. The press release easily leaves the impression that such individuals are simply the "more-likely-exposed" individuals within the population. No reference is made to the strictly "theoretical" nature of the MEI.

Furthermore, no expression of the risk was made other than to state the value in terms of lifetime individual cancer risk. Stating that the risk is 1 in 167 does not convey the same meaning as, say, reporting that the risk is "one additional chance of cancer for an individual living in Soda Springs for 12,000 years." And yet both are equivalent statements.

Use Risk Comparisons To Help Put Risks In Perspective (EPA Rule #7)

Nowhere does the EPA release explain what a "4 in 10,000" increased cancer risk means in terms that are familiar. And yet the EPA's own Science Advisory Board has expressly stated with reference to radionuclides that "comparisons of these estimated risk levels with other commonly encountered and accepted risks is necessary for perspective."13/

For example, the estimated radiation risk of "4 in 10,000" is approximately the same as the increased risk assumed by a person who lives in Denver, Colorado, rather than in Portland, Oregon. Comparisons of that type "help

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12/ National Research Council, Risk Assessment in the Federal Government: Managing the Process, (June 1985), p. 25.

13/ U.S. Environmental Protection Agency, Science Advisory Board, Subcommittee on Risk Assessment for Radionuclides, "Report on the Scientific Basis of EPA's Proposed National Emission Standards for Hazardous Air Pollutants for Radionuclides" (August 1984), p. 4.

individuals steer a prudent course between risks of various sizes."14/ Again, in the words of Mr. Ruckelshaus:

> [W]e must search for ways to describe risk in terms that the average citizen can comprehend. We need to describe the suspect substances as clearly as possible, tell the people what the known or suspected health problems are and help them compare that risk to those with which they are more familiar.15/

If the EPA is to maintain a reputation as a credible regulatory agency, it must adhere to the accepted standards of risk communication. Deviating from those standards holds the Agency up to the criticism of "fear-mongering," and leaves the Agency defenseless even when the accusation is false. Consequently, I strongly urge you to correct the inadequate risk communication we have seen with the recent release of the "Idaho Radionuclide Study".

I fully intend to follow-up on the Agency's activities in this regard. In that vein, I would like to notify you of an oversight hearing of the Senate Environment Committee, Nuclear Regulation Subcommittee, scheduled for August 21, in Soda Springs, Idaho. The EPA is respectfully requested to testify, and I hope that testimony will detail the efforts being made to improve the Agency's risk communication skills on this issue.

With best regards, I am

Yours for a free society,

Steve Symms

STEVE SYMMS
United States Senator

SS:tlc

Enclosure

14/ National Research Council, Improving Risk Communication, p. 172.

15/ William D. Ruckelshaus, "Science, Risk, and Public Policy," Address before the National Academy of Sciences, June 23, 1983.

THE NAS RISK MESSAGE CHECKLIST AND EPA'S 'PHOSPHATE SLAG' RELEASE COMPARED

Checklist Item	EPA 'Slag' Release
Information About the Nature of Risks	
1. What are the hazards of concern?	Partially Present
2. What is the probability of exposure?	Not Present
3. What is the distribution of exposure?	Not Present
4. What is the probability of harm from a given exposure to each hazard?	Not Present
5. What are differing population sensitivities?	Not Present
6. Does exposure interact with other hazards?	Not Present
7. What are the qualities of the hazard?	Not Present
8. What is the total population risk?	Not Present
Information About the Nature of Benefits	
1. What are the associated benefits?	Not Present
2. Are the benefits independent of the harm?	Not Present
3. What are the qualities of the benefits?	Not Present
4. Who benefits and in what ways?	Not Present
5. How may people benefit and for how long?	Not Present
6. Does anyone receive more benefit than others?	Not Present
7. What is the total benefit?	Not Present
Information on Alternatives	
1. What are the alternatives to the hazard?	Not Present
2. How effective are the alternatives?	Not Present
3. How does action and inaction compare?	Not Present
4. How are costs and benefits of alternatives distributed?	Not Present
Uncertainties in Knowledge About Risks	
1. What are the weaknesses of available data?	Not Present
2. What assumptions were used?	Not Present
3. How sensitive are estimates to assumptions?	Not Present
4. How sensitive are decisions to estimates?	Not Present
5. What other assessments have been made?	Not Present
Information on Management	
1. Who is responsible for the decision?	Not Present
2. What issues have legal importance?	Not Present
3. What factors constrain the decision?	Not Present
4. What resources are available?	Not Present

SOURCE: Improving Risk Communications -- Recommendations
National Research Council, National Academy Press, 1989

Senator SYMMS. Furthermore, I would like to ask EPA to submit in writing for inclusion in the hearing record at a later date not necessarily a rebuttal of the letter or a refutation, but just a detailed point-by-point information sheet providing the information that that letter claims to have not been provided to the population of this part of Idaho.

I think you've seen the letter. Do you think that it's possible that a point-by-point information sheet could be prepared between now and the end of the month?

Mr. SCHILLING. We can try, Senator, to do just that.

Senator SYMMS. We would like to close this hearing record in a reasonable time. Let's see, it's the 21st—sometime in the middle of September, so in two or three weeks we would like to have that done.

I will also submit to the agency for written response the questions that Congressman Craig has provided to the committee.[1]

[The point-by-point information response follows:]

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[1] Responses from EPA to written questions from Congressman Craig and the committee, were not received by time of publication.

POINT-BY-POINT RESPONSE

Information About the Nature of Risks

1. **What are the hazards of concern? —**

EPA's May 1990 fact states that "Gamma radiation from slag was the primary health concern evaluated by the study". In addition, the fact sheet describes how the radiation comes to be associated with slag and air emissions of radionuclides.

2. **What is the probability of exposure? —**

EPA's fact sheet states that "Anyone living or working in Pocatello or Soda Springs is likely to be exposed to higher than normal amounts of radiation, mostly from slag paved streets and sidewalks and from homes with slag-containing foundations. The range of exposure, however, may vary significantly from person to person." The fact sheet provides examples of different living and working conditions that would influence the magnitude of an individuals exposure to slag-associated radiation.

3. **What is the distribution of exposure? - —**

EPA recognizes that exposures within a population may vary. For this reason, risk information was presented in the May fact sheet for average and maximally exposed individuals. In the absence of precise information about the living and working conditions of individual residents of Soda Springs and Pocatello, it is impossible to accurately determine an individual's personal risk or to develop an accurate community-wide distribution of exposure. Further testing, and even individual counseling, will be required to provide accurate exposure levels for individuals.

4. **What is the probability of harm from a given exposure to each hazard? -**

The risks to individuals exposed to slag-associated radiation under average and maximum exposure conditions are clearly presented in the fact sheet. The fact sheet states "The overall conclusion of the report is that lifetime exposure (70 years) will result in an increased probability or chance of getting cancer. Based on EPA's calculations, the average lifetime exposures would result in an increased cancer risk of 4 in 10,000 in Pocatello and 14 in 10,000 in Soda Springs. In the case of the maximally exposed individuals, the risk could be as high as 1 in 250 in Pocatello and 1 in 167 in Soda Springs."

5. **What are differing population sensitivities? ––**

Although this issue was not addressed in the May 1990 fact sheet, it is addressed in a subsequent fact sheet issued on in August 1990.

6. **Does exposure interact with other hazards? ––**

It is not known whether radiation risks associated with slag are enhanced or decreased in association with exposure to other hazards. Therefore, this issue was not addressed by EPA in communicating slag risks to the public.

7. **What are the qualities of the hazard? ––**

The qualities of the hazard are clearly described in EPA's fact sheet. The fact sheet states, "Gamma rays (like X-Rays) are capable of penetrating body tissue. With sufficient exposure, gamma rays are known to cause a variety of cancers in humans....it is necessary to be in close proximity (a few yards) to sources of gamma radiation for extended periods of time (years) in order to reach the highest risk levels described in the report."

legal ramifications of the Idaho Radionuclide Study were not discussed in the fact sheet.

3. **What factors constrain the decision? ——**

Additional information on gamma radiation levels in specific homes is required to determine whether individual buildings should be remediated. This need is stated in the May fact sheet under the heading "What Is Going To Be Done?".

"Action levels" (i.e., radiation levels above which EPA recommends corrective action) need to be established before decisions can be made about the need for remediation of specific homes and roads. Because the EPA intends to seek public comment before making decisions on action levels and home testing procedures, EPA had not selected action levels at the time of the release of the fact sheet and public meetings. The Agency is currently in the process of identifying action level options and will submit those options to the public for formal comment before a final decision is made.

While one might argue that EPA should have waited before presenting the risk results to the communities until these decisions had been made, the Agency believed that the magnitude of the risks warranted early release of the information. In addition, EPA now has the opportunity to involve the citizens of Soda Springs and Pocatello in the risk management decisions that affect their lives. The rationale for releasing the Idaho Radionuclide Study prior to having specified action levels selected was discussed at the public meetings in Soda Springs and Pocatello.

4. **What resources are available? ——**

The May 1990 fact sheet indicated that EPA would be sponsoring additional voluntary home testing in Soda Springs and is considering additional home testing in Pocatello. Until the results of home testing can be used to characterize the magnitude of the problems and to determine whether in fact remedial action is warranted, it is not possible to establish the need for resources to address the problem.

because the study was designed merely to indicate whether segments of the populations of both Soda Springs and Pocatello are being exposed to slag-associated radiation levels that present a potential health hazard. The study was not designed to identify who is specifically at risk or how great the risk is to a specific individual. Additional specific information will be necessary in order for the community and EPA to make appropriate risk management decisions. As stated in the May 1990 fact sheet, the ability for EPA to characterize potential radiation problems in individual homes will be dependent on the results of additional home testing.

5. **What other assessments have been made? ––**

EPA did not discuss other assessments of health risks associated with low level radiation exposure in the May 1990 fact sheet. However, the scientific underpinnings of the Idaho Radionuclide Study and the weight of scientific evidence supporting EPA's conclusions about potential health risks were discussed at the public meetings held when the report was released. In addition, EPA provided time for Monsanto Company and FMC Corporation to present the results of their studies on slag-associated health risks at the EPA public meetings.

Information on Management

1. **Who is responsible for the decision? -**

The last sentence of the May 1990 fact sheet states, "Over the course of the next few months, EPA, with the help of state and local authorities and the community, will develop a comprehensive, long range strategy for minimizing both the current and future risks associated with slag exposure."

2. **What issues have legal importance? ––**

The predominant legal issue is the potential financial liability to those who sold or distributed slag. Until the health risks are better characterized through additional home testing, and decisions are made on the need for home and road remediation, EPA cannot comment publicly about the likelihood or magnitude of potential liability for specific individuals or companies. For this reason, the potential

8. **What is the total population risk? —**

The risk values included in the May 1990 fact sheet can be viewed as population risks (i.e., 4 additional cancers in a population of 10,000 Pocatello citizens exposed under average conditions) or individual risks (i.e., a Pocatello resident exposed under average conditions increases his/her personal risk of getting cancer by 4 chances in 10,000). Although the risk values were presented, EPA could have provided a more thorough interpretation of these values.

Information About the Nature of Benefits

Questions 1 - 7 —

To EPA's knowledge, no quantitative information is available on the extent to which slag use in home and road construction results in enhanced safety benefits to residents or drivers. Further, to EPA's knowledge no quantitative information is available on the number of people receiving these potential benefits. For this reason, the economic and health benefits associated with the use of slag for construction purposes were not discussed in the fact sheet.

EPA's August 1990 fact sheet did, however, address the issue of economic concerns. The August fact sheet recognizes that costs associated with roads constructed using slag are lower than costs associated with roads constructed using alternate aggregate. In addition, the fact sheet acknowledges that slag currently represents a source of jobs and revenue for companies that sell the material and that restrictions on the future use of slag could have adverse economic impacts.

Information on Alternatives

Questions 1 - 4 —

Prior to releasing the final Idaho Radionuclide Study, EPA asked the Bureau of Land Management to assess the availability of alternative sources of sand, gravel and other rock material in the Pocatello and Soda Springs area. Due to the brief nature of the fact sheet, EPA did not address this issue in the fact sheet. However, this issue was discussed briefly at the public meetings held in Soda Springs and Pocatello at the time of the release of the final report, and has been discussed with local officials.

Uncertainties in Knowledge About Risks

1. **What are the weaknesses of available data? —**

The May 1990 fact sheet does not identify specific weaknesses in the data collected in support of the Idaho Radionuclide Study.

2. **What assumptions were used? —**

The May 1990 fact sheet did not include an exhaustive list of the assumptions that were used in calculating the potential health risks. This information is contained in the Idaho Radionuclide Report. However, the fact sheet did indicate that risks were calculated assuming a lifetime (70 year) exposure for two generic population subgroups: maximally exposed individuals and average exposures. The fact sheet stated, "For maximally exposed individuals, the risks were based on a "worst case combination of exposures in the home, workplace and during outdoor activity. Average exposures were calculated using assumptions which were considered to be characteristic of a much wider segment of the population."

3. **How sensitive are estimates to assumptions? —**

The May 1990 fact sheet clearly states that the risk assessment conducted for the Idaho Radionuclide Study "combines scientific facts and assumptions to calculate probabilities that radiation exposures will result in human cancer". Further, the fact sheet states, "Because risk estimates...depend on a number of unproven assumptions which can change over time, calculated or theoretical risk values may over or underestimate actual risks." Examples are provided in the fact sheet to illustrate how the predicted slag-associated risk values may have been affected by the use of different assumptions.

4. **How sensitive are decisions to estimates? —**

The risk estimates presented in the Idaho Radionuclide Study will not drive risk management decisions. This is

Senator SYMMS. But when I hear the testimony presented here this morning by the other witnesses, and Mr. Horan's testimony, it concerns me. Is it not true that the background for millirems of gamma radiation, here in this part of the State, is 100, Mr. Findley?

Mr. FINDLEY. Can we call on Rich Guimond to answer that? I think he's much more familiar with it.

Senator SYMMS. One hundred millirems, is that correct?

Admiral GUIMOND. About 100 or 101.

Senator SYMMS. And Mr. Horan, you said in your statement that 300 is normal, worldwide?

Mr. HORAN. I included radon, and radon contributes about 200 millirems per year to the average person in the United States.

Senator SYMMS. So then if you add 51 more millirems for a sidewalk, that makes 150 and that's still not out of the range of what's acceptable, in your opinion?

Mr. HORAN. That is correct. If the 51 is a correct figure.

Senator SYMMS. If the 51 is a correct figure.

In your opinion then, Mr. Findley, is the 51 a correct figure?

Mr. FINDLEY. Senator, I'm not trying to dodge your questions. I'm just not the scientist in the crowd here. I'll turn that over to Rich.

Admiral GUIMOND. I think you should understand one thing on the number, between 100 and 300.

First of all, when we deal with external radiation— gamma radiation, which is the 100—the cancer risks that you are talking about there tend to be leukemia and other types of cancers. At a number of 200, which may be an average number for people exposed to radon, the level of risk is lung cancer. There are different effects——

Senator SYMMS. But suppose somebody's exposed to a sidewalk.

Admiral GUIMOND. Well, if you take a look at——

Senator SYMMS. You're talking 24 hours a day for a year, correct?

Admiral GUIMOND. No, not for the 50. The 50 millirem numbers that were described for the average population in, say, the Soda Springs area, it would be an average exposure for what they were doing throughout their whole year—their type of existence, some amount of time on the sidewalk, some amount of time in their homes, some amount of time in various other places.

If you just spent the full amount of time in the highest areas where there is the highest exposure, on the sidewalk, if you were there 100 percent of the time, you'd have greater than 50 millirem per year. So that does not have that kind of an assumption.

Senator SYMMS. Well, let me just read a paragraph here from the EPA Science Advisory Board. This is dated June 22d.

> Members of the Radiation Advisory Committee have called me because they are concerned over statements they have read in the press that the Science Advisory Board reviewed EPA's results. There was no such review. Indeed, the members of the committee have not even received an information copy of the study, nor were they copied on any press releases distributed by the agency on this topic. The members are in the embarrassing position of having received calls about the review of a document they have never seen.

How did the press get this inaccurate perception, then? That's the question, how did this get out to the press?

It scared a lot of people. I guess the question I'm trying to ask is, is there really a risk here? And if not, why are we trying to scare everybody? What's the purpose of this?

Mr. SCHILLING. The role of the Science Advisory Board was mistakenly characterized in our public meeting over here. We were under the impression at the public meeting that the Science Advisory Board actually had reviewed the final results. Such was not the case. The Science Advisory Board did review the protocol for the study, and there was some confusion which basically happened because we had a change within the agency on who was handling the study and how it was going to be distributed to the public, and we goofed. We apologize for that.

We are now going to go back to the Science Advisory Board and brief them on October 23d on the study. They do have copies at this point, and we are playing catch-up, but we intend to make this right.

Admiral GUIMOND. Let me make one comment relative to that.

My office does all the scientific work. We deal with the Science Advisory Board a lot, and typically the way we do this is that before we begin a study, we go with the design of the study to them to ensure that it is scientifically accurate and will do a credible job. In addition, every time we would come up with new scientific information—new international studies that come out—to come up with what we call "unit risk figures," get an idea of how much risk there is per unit of exposure to radiation, we ask the Science Advisory Board to review our proposals there and give us specific information.

In this particular case we did that with the Science Advisory Board over the past several years, and the recommendations that they gave us are the ones that were incorporated in this study.

Senator SYMMS. The recommendations were the ones you took, or did you ignore their recommendations?

Admiral GUIMOND. No, we did not ignore the recommendations. All the recommendations of how to design the study, of what unit risk factors to use, all of that to do the risk assessment were accepted into the design of our study.

Mr. SCHILLING. If I may add a quick point here, I think what we are talking about is in the realm of our fourth cardinal rule for effective risk communication, that is, be honest, frank, and open. In this variation, part of the rule implies "don't make mistakes out of ignorance," which we did here. The other part of the rule implies, "acknowledge them when you do them and try to go on forward" and collaborate as well as you can.

Senator SYMMS. Okay, I thank you very much for that addition.

Mr. Horan, I have here an article published in the Scientific American, "The Biological Effects of Low-Level Ionizing Radiation: What is the Hazard to Human Beings of Low- Level Radiation from Natural and Artificial Sources?" It says, "The evidence so far indicates that compared with other hazards, it is slight." It is by Arthur C. Upton. Are you familiar with him?

Mr. HORAN. Yes, I am, Senator.

Senator SYMMS. Are you familiar with this article? Would you rate him as a credible scientist? Is he credible in the scientific community?

Mr. HORAN. Yes, he is. Among his credentials, and I am trying to recall now—first of all, he was a research scientist and director at Brookhaven National Laboratory for a number of years, perhaps even decades. Then he was appointed the Director of the National Cancer Institute in Washington. And now I believe, but I'm not certain about this, he is back at Brookhaven National Laboratory. But he is a member of the ICRP, the International Commission on Radiological Protection. He is a very dynamic and active member of NCRP. And I believe he was the Chairman of the BEIR V Committee, as well.

Mr. SCHILLING. That is correct.

Mr. HORAN. But as far as the document is concerned, I remember seeing a part of it. The public questionnaire, which is in the back, is what I'm more familiar with.

Senator SYMMS. Well, let me just ask one other question.

First I would like to insert this in the record at this point in the testimony.

[The article referred to follows:]

Established 1845 SCIENTIFIC AMERICAN February 1982 Volume 246 Number 2

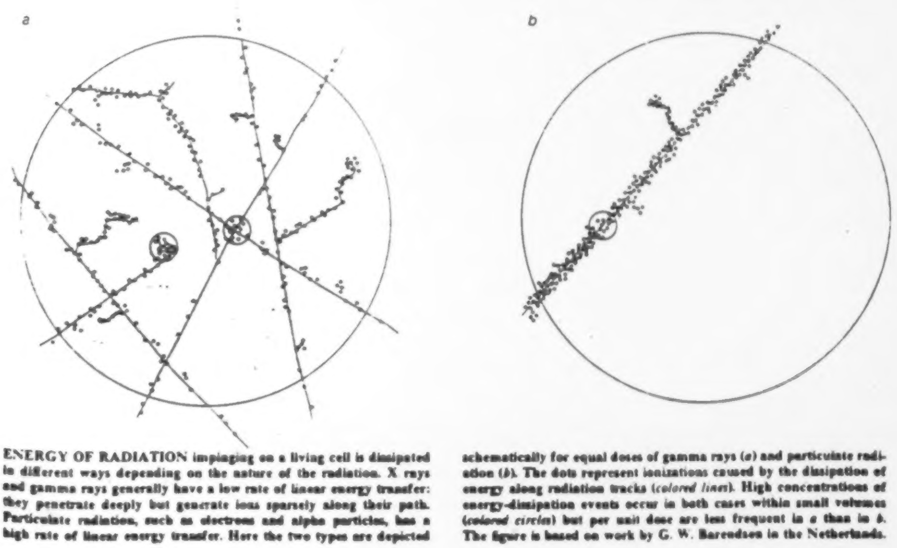
The Biological Effects of Low-Level Ionizing Radiation

What is the hazard to human beings of ubiquitous low-level radiation from natural and artificial sources? The evidence so far indicates that compared with other hazards it is slight

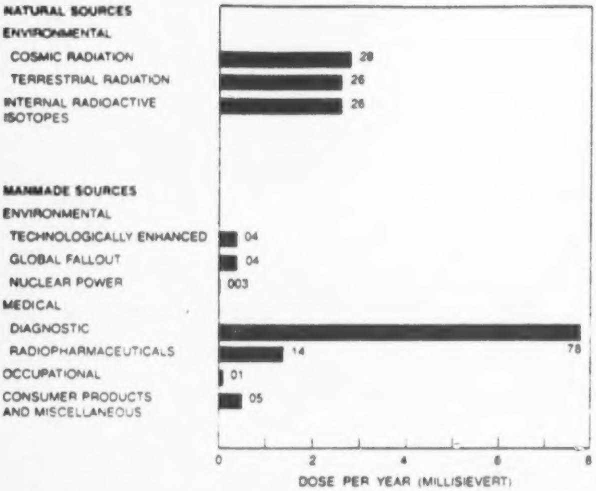
by Arthur C. Upton

Everyone is bathed throughout life with low-level ionizing radiation from natural sources. For the average person the lifetime exposure is virtually doubled by radiation from manmade sources, chiefly medical. Since radiation can cause cancers and genetic defects, the question arises of exactly how hazardous the low-level radiation from background and manmade sources is. The question has been intensively investigated for many years, and the evidence assembled so far indicates that the hazard, if it is real, is too small to be detectable. Hence compared with other hazards to which people are regularly exposed, the overall hazard from low-level ionizing radiation would not appear to be any cause for concern.

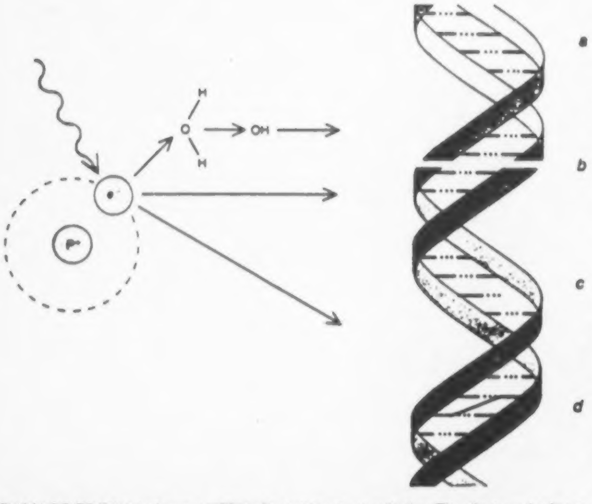
A related question has to do with thresholds. Is the effect of low-level ionizing radiation cumulative, or is ionizing radiation harmful only if it exceeds some threshold level? On this question the evidence is more ambiguous. It is clear that for certain types of radiation and certain effects the impact of radia-



ENERGY OF RADIATION impinging on a living cell is dissipated in different ways depending on the nature of the radiation. X rays and gamma rays generally have a low rate of linear energy transfer: they penetrate deeply but generate ions sparsely along their path. Particulate radiation, such as electrons and alpha particles, has a high rate of linear energy transfer. Here the two types are depicted schematically for equal doses of gamma rays (*a*) and particulate radiation (*b*). The dots represent ionizations caused by the dissipation of energy along radiation tracks (*colored lines*). High concentrations of energy-dissipation events occur in both cases within small volumes (*colored circles*) but per unit dose are less frequent in *a* than in *b*. The figure is based on work by G. W. Barendsen in the Netherlands.



RADIATION EXPOSURE of a typical person in the U[illegible]rom natural and manmade sources is represented in millisieverts. One [illegible] is the amount of any radiation equal in biological effect to 100 rads (a rad is 100 ergs per gram of tissue) of gamma rays. The total average dose rate per year is .8 millisievert from natural sources and 1.06 millisieverts from manmade sources. A typical dental X ray delivers about one millisievert to the center of the cheek.



DAMAGE TO DNA is the most critical effect of low-level radiation. The effect can be direct or indirect. At the left a hydrogen atom, consisting of one proton and one electron, is ionized. (The electron is dislodged when the atom absorbs a photon of radiation.) In the indirect effect (*top arrow*) a secondary electron interacts with a molecule of water (H_2O) to give rise to a free radical (OH), which does the damage to the DNA. In the direct effect (*lower arrows*) the electron itself interacts with the DNA. The schematic representation of DNA at the right shows a normal segment of the molecule (*a*) and three of the many types of damage that can be caused by either direct or indirect effects of ionization: a double-strand break in the DNA double helix (*b*), the deletion of a base (*c*) and the chemical cross-linking of the two DNA strands (*d*).

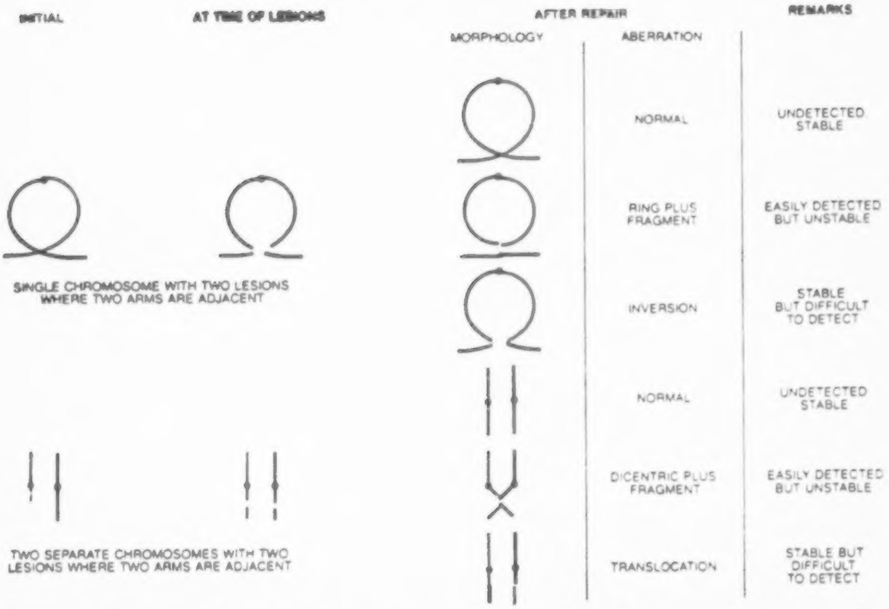
tion is indeed cumulative. For other, however, it seems more plausible to postulate a threshold.

Ionizing radiation, in contrast to other forms of radiant energy, can impart enough localized energy to an absorbing material to ionize (remove electrons from or add them to) atoms and molecules in its path. Some ionizing radiation is electromagnetic and some consists of subatomic particles of various masses and charges. The electromagnetic ionizing radiation includes X rays and gamma rays, which are characterized by relatively short wavelength and high frequency. The particulate radiations include electrons, protons, neutrons and alpha particles.

Quantities and doses of ionizing radiation are measured in several units. The oldest unit is the roentgen, which is a measure of the quantity of ionization induced in air. The principal units used to express doses absorbed by living matter are the rad (one rad equals 100 ergs per gram of tissue) and the gray (one gray equals one joule per kilogram of [illegible] or 100 rads). Since for a given dose particulate radiations ordinarily cause more injury than X rays or gamma rays, the units called the rem and the sievert have been introduced so that doses of different kinds of radiation can be compared for their biological effects. One rem, defined loosely, is the amount of any radiation that produces a biological effect equivalent to that resulting from one rad of gamma rays. Similarly, one sievert is the amount of any radiation that is equivalent in biological effect to one gray of gamma rays; one sievert therefore equals 100 rems. The units employed for expressing collective doses are the person-rem and the person-sievert, each of which is obtained by a multiplication: the average dose per person times the number of people exposed. For example, one rem to each of 100 people equals 100 person-rems or one person-sievert.

The natural background radiation is composed principally of (1) cosmic rays; (2) emissions from the disintegration of uranium, thorium, radium and other radioactive elements in the earth's crust, and (3) emissions from potassium 40, carbon 14 and other radioactive isotopes occurring naturally in the body. Collectively the average dose to internal organs received from these three sources by a person living at sea level is about .8 millisievert (80 millirems) per year. A dose twice that size may be received by people living at higher elevations, where cosmic rays are more intense, or in regions where the radium content of the earth is fairly high.

The largest contribution from manmade sources comes from medical diagnosis, which is estimated to approach the dose received from the natural background. (The contributions from differ-


INITIAL
AT TIME OF LESIONS
AFTER REPAIR
MORPHOLOGY
ABERRATION
REMARKS
NORMAL
UNDETECTED STABLE
RING PLUS FRAGMENT
EASILY DETECTED BUT UNSTABLE
INVERSION
STABLE BUT DIFFICULT TO DETECT
SINGLE CHROMOSOME WITH TWO LESIONS WHERE TWO ARMS ARE ADJACENT
NORMAL
UNDETECTED STABLE
DICENTRIC PLUS FRAGMENT
EASILY DETECTED BUT UNSTABLE
TRANSLOCATION
STABLE BUT DIFFICULT TO DETECT
TWO SEPARATE CHROMOSOMES WITH TWO LESIONS WHERE TWO ARMS ARE ADJACENT

DAMAGE TO CHROMOSOMES by radiation is often repaired by the body but is sometimes misrepaired, resulting in chromosomal abnormalities. The situation is depicted for a single chromosome (*top*) with a radiation-induced lesion in each arm and for two separate chromosomes (*bottom*), each with a lesion in one arm. If the two breaks are not too close in space and time, the repair mechanism restores the chromosome to its normal condition. If such aberrations are close in space and time, abnormalities can arise from various kinds of misrepair. This depiction is based on work by Malcolm L. Randolph and J. G. Brewen of the Oak Ridge National Laboratory.

ent kinds of medical and dental examination vary widely.) Other manmade sources include radioactive minerals that are present naturally in certain types of crushed rock, building materials and phosphate fertilizers; radiation-emitting components of television sets, smoke detectors and other consumer products; fallout from atomic weapons, and leakage from nuclear reactors.

X rays were applied in the diagnosis and treatment of disease within months of their discovery by W. K. Röntgen in 1895. Harmful side effects of the radiation were encountered almost immediately. The first such effects, which often appeared within hours or days after exposure, were transitory injuries such as reddening and blistering of the skin. By 1902 it was recognized that a delayed effect of radiation could be the development of cancer. The first such case of cancer to become known arose at the site of long-standing skin damage on the hand of a radiologist. In ensuing decades, before adequate safety measures were adopted, scores of similar cancers appeared among pioneer workers with radiation. Because such cancers were characteristically preceded by a long history of progressive radiation-induced skin damage it was generally assumed that radiation gave rise to cancers only if the dose was large enough to cause gross injury. This was a form of the threshold concept.

The possibility that cancers might result from small doses of radiation was not considered seriously until the 1950's, when E. B. Lewis of the California Institute of Technology inferred (from the heightened frequency of leukemia in survivors of the atomic bombings of Japan, in radiologists and in certain groups of patients treated with X rays for noncancerous conditions) that the incidence of cancers might increase as a linear, nonthreshold function of the dose. Such a dose-effect relation seemed consistent with the hypothesis that leukemia could result from a radiation-induced mutation in a single blood-forming cell. On this concept Lewis postulated that from 10 to 20 percent of all cases of childhood leukemia might be attributable to natural background radiation.

Lewis' interpretation, implying that no dose of radiation is without some carcinogenic risk, generated concern and controversy that have continued to this day. Although the existence of a threshold for carcinogenic effects is no longer postulated in setting limits of exposure to ionizing radiation, the magnitude of the risk that may be attributable to low-level radiation continues to be under inquiry.

Heritable effects of ionizing radiation (effects transmitted to descendants) have long been postulated to have no threshold and therefore to represent a risk associated with low-level radiation. On the other hand, certain nonheritable effects have been documented clinically only at high levels; they therefore appear to have a threshold. Included in this category are the opacification of the lens of the eye, the impairment of fertility and the depression of the number of white cells in the blood. Similarly, radiation-induced disturbances in the development of the embryo apparently result from doses large enough to kill many cells in the affected tissues and so are regarded as unlikely to be caused by exposure at the low levels characteristic of natural background radiation.

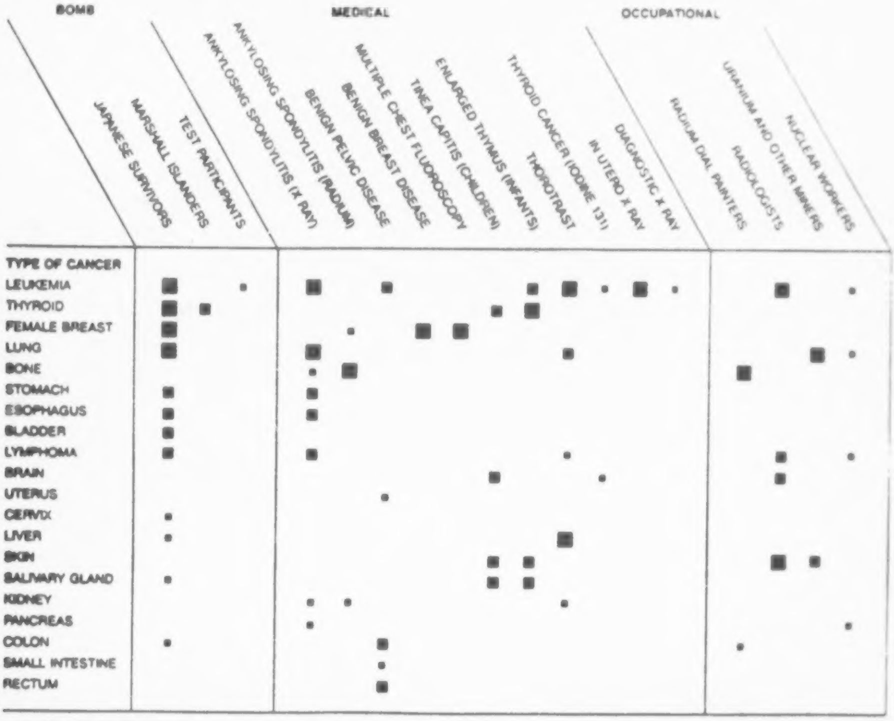
Carcinogenic and heritable effects therefore constitute the principal health hazards associated with small doses of radiation. The nature of these effects and their relation to an individual's exposure to radiation must be analyzed in assessing the risks of low-level irradiation. Such an analysis calls for somewhat more detailed consideration of the interactions of ionizing radiation with living cells.

As ionizing radiation penetrates living tissue it gives up its energy through a series of random collisions and interactions with the atoms and molecules in its path. The collisions and interactions give rise to ions and reactive chemical radicals, which break chemical bonds and cause other changes in molecules in their vicinity. The distribution of ionization events along the path of the impinging ray or particle depends on the energy, mass and electric charge of the radiation, and to a lesser extent on the density of the absorbing tissue. In general X rays and gamma rays (which are electrically neutral) are characterized by a low rate of linear energy transfer, that is, they generate ions sparsely along their tracks and penetrate deeply into tissue. Charged particles are characterized by a higher linear energy transfer and shallower penetration. The capacity to cause damage is correlated with the density of the deposition of energy. Radiations of high linear energy transfer (such as protons and alpha particles) are generally more damaging than radiations of low linear energy transfer (such as X rays and gamma rays).

An injury to a cell results from the molecular changes caused by radiation-induced ions and free radicals. Among the many types of molecule that are affected by ionizing radiation the most critical is DNA because of the limited redundancy of the genetic information encoded in it. The total amount of energy deposited by an acutely lethal dose of X rays affecting the whole body (about three to five sieverts) causes hundreds of breaks in DNA molecules in every cell of the body.

The damage to DNA along a track of radiation with low linear energy transfer is likely to consist of fairly simple lesions such as single-strand breaks in the two-strand double helix of DNA. Several lesions are likely with radiation of higher linear energy transfer. Since the simple types of lesion can to a considerable extent be repaired by enzymes in the cells, the damage to DNA that ultimately results in a given instance may depend as much on the effectiveness of the repair processes as it does on the nature of the initial lesion. The effects of an unrepaired or misrepaired lesion in a single molecule of DNA may be amplified many times as the DNA is transcribed and translated; ultimately it can be transmitted to countless numbers of daughter cells. If only for this reason, damage to chromosomes and genes appears to figure more prominently than any other type of damage in the injuries resulting from low-level irradiation.

Chromosomal abnormalities constitute one of the most thoroughly studied effects of radiation. The abnormalities include changes in the number and structure of chromosomes. They result from the breakage and rearrangement



INCIDENCE OF CANCER associated with radiation is charted for people exposed to radiation in three different circumstances: the atomic bombings of Japan, radiation therapy and occupational exposure. A strong association of a certain type of cancer with a certain type of exposure is indicated by the large squares, a meaningful association by the squares of medium size and a suggestive but unconfirmed association by the small squares. The three groups are the ones in which the exposure to radiation is fairly well documented.

of chromosome fibers and from interference with the normal segregation of chromosomes when the cell divides.

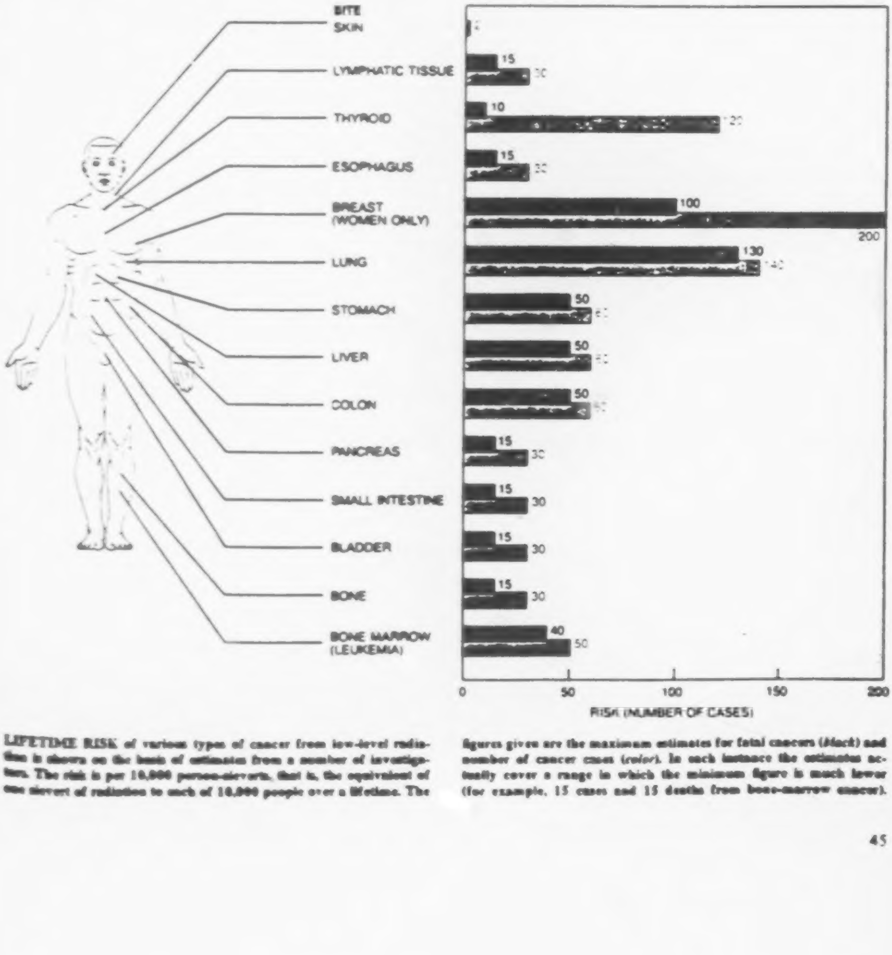
With metabolic repair processes a cell can rejoin the ends of a broken chromosome. When two breaks are close enough together in space and time, however, the broken ends from one break may be joined incorrectly with those from another, giving rise to translocations, inversions, rings and other types of structural rearrangement. The frequency of such chromosomal aberrations increases as a linear, nonthreshold function of the radiation dose in the low-to-intermediate range. When the number of chromosomal injuries is plotted as a graph, the slope of the line is steeper for radiation with high linear energy transfer than it is for radiation with low energy transfer. With increasing dose and dose rate the slope for low-transfer radiation increases, but it remains essentially unchanged for high-transfer radiation.

From these dose-effect relations it can be inferred that a chromosomal aberration has a small probability of being caused by low-transfer radiation unless two or more radiation tracks traverse a given region of the cell nucleus in close enough succession to enable the chromosomal lesions arising along one track to interact with those along another. In contrast, the lesions resulting from a single traversal of high-transfer radiation have a high probability of interacting with one another, independently of the lesions resulting from another traversal.

The frequency of chromosomal aberrations in lymphocytes (one type of white blood cells) taken from the circulating blood and maintained in a culture medium is detectably increased in people who work with radiation and in other people exposed to radiation. The combined frequency of such aberrations, scored soon after irradiation in vitro, approximates .1 per cell per sievert, from which the dose required to double their frequency can be calculated to approximate .05 sievert, or about 60 times the dose ordinarily received per year from natural background radiation. Such aberrations are also increased in frequency by certain viruses, chemicals and drugs. The majority of such aberrations are unstable in that they interfere with division in the affected cells; such cells fail to reproduce and gradually disappear.

The mutagenic action of radiation on genes has been studied extensively in a wide variety of organisms since its discovery in 1927 by H. J. Muller. Although no heritable effects of radiation have yet been demonstrated in human populations, the wealth of relevant information from other species provides a basis for predicting such effects in man. The most pertinent data come from experiments with mice.

In these experiments the dose-effect relation for the induction of mutations



LIFETIME RISK of various types of cancer from low-level radiation is shown on the basis of estimates from a number of investigators. The risk is per 10,000 person-sieverts, that is, the equivalent of one sievert of radiation to each of 10,000 people over a lifetime. The figures given are the maximum estimates for fatal cancers (*black*) and number of cancer cases (*color*). In each instance the estimates actually cover a range in which the minimum figure is much lower (for example, 15 cases and 15 deaths from bone-marrow cancer).

in spermatogonia and oocytes (maturing sperm and eggs) is quite similar to the one for chromosomal aberrations. With high-transfer radiation the frequency of mutations increases steeply in proportion to the dose but is relatively independent of the dose rate. (The dose is the total amount of radiation energy deposited in a tissue or cell regardless of time; the dose rate is the amount of radiation energy per unit of time.) With low-transfer radiation the frequency of mutations increases less steeply as a function of the dose but is highly dependent on the dose rate.

In considering these matters one's attention turns to the genetic effects of the atomic bombings and the natural background radiation. No detectable increase in genetic abnormalities has appeared among the children of people who survived the two atomic bombings. The failure to detect an increase is not incompatible with the induction rate observed in mice, considering the smallness of the sample (78,000 children) and the low average dose (.5 sievert) to the gonads of the parents.

The information available at present suggests that the dose required to double the human mutation rate lies between .2 sievert and 2.5 sieverts. On the basis of this value assessments have been made of the contribution of the natural background radiation to the frequency of various types of genetically determined disease in the population. Although such assessments are highly uncertain, since it is difficult to relate the amount of genetic disease in the population to the mutation rate alone, they imply that only a small amount (from .1 to 2 percent) of all genetically determined disease is attributable to the natural background radiation.

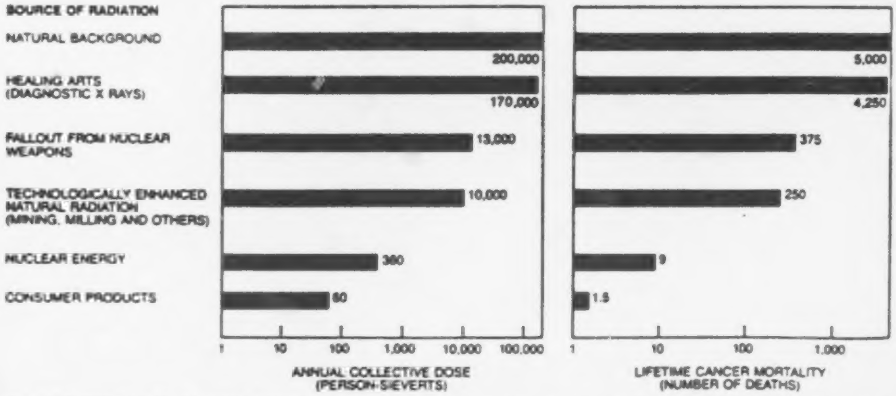
Most but not all types of cancer are increased in frequency by radiation. The increase depends on the conditions of exposure and on factors affecting the susceptibility of the exposed population. A serious difficulty is that radiation-induced cancers have no distinguishing features by which they can be recognized as such. Moreover, they do not appear until years or decades after the irradiation. A causal relation between a cancer and previous irradiation can therefore be inferred only on the basis of the appropriate epidemiological evidence. The three best sources of such evidence are studies made of people who survived the atomic bombings, patients exposed to radiation for medical purposes and workers exposed to radiation in their occupations.

Because the frequency of cancer of any one type is relatively low the analysis of the mathematical relation between dose and incidence calls for the study of sizable populations. Furthermore, because of the large number of subjects and the long time elapsing between irradiation and the appearance of cancer such studies are usually complicated by uncertainties about the size of the radiation dose to affected individuals and the possible influence of risks other than radiation. Nevertheless, different irradiated populations show a remarkable consistency in the extent to which their rates of cancer vary in relation to the estimated dose of radiation. At the same time the data come mainly from fairly high doses of radiation (.5 sievert to two sieverts), so that the carcinogenic risks of low-level radiation can be estimated only by an extrapolation based on tentative assumptions about the dose-incidence relation.

The information about this relation more extensive for leukemia and fo breast cancer in women than it is for an other human cancer. The data come from several populations and cover a considerable range of doses. For leukemia all types of the disease except the chronic lymphatic type increase in incidence with dose. In the first 25 years after irradiation the total cumulative excess of all types combined amounts to approximately one case per year per 10,000 persons at risk per sievert of radiation to the bone marrow.

The consistency from group to group in the figures for breast cancer is noteworthy in view of the differences among populations in the duration of exposure. Irradiation was almost instantaneous for people exposed in the atomic bombings, was generally received in from one to four exposures on successive days b women under radiation therapy and wa accumulated over many months (in increments of from .01 to .05 sievert) by women who received repeated fluoroscopic examinations of the chest during treatment for pulmonary tuberculosis. (The treatment entailed the collapsing of a lung; the fluoroscopic examinations were made to ensure that the lung had not begun to expand again.) The fact that the excess of cancer cases per unit dose is not detectably smaller in the third group than it is in the others suggests that successive, small, widely spaced exposures are fully additive in their cumulative effect on the tissue of the breast. The absence of detectable repair between such small and widely spaced exposures is consistent with a linear nonthreshold relation between dose and incidence.

Further evidence of carcinogenic effects from low doses is available from



CONTRIBUTION OF RADIATION EXPOSURE to the burden of fatal cancers in the U.S. population is charted on the basis of a number of estimates. The annual dose from each radiation source is expressed in person-sieverts. The total number of fatal cancers is less than 10,000 annually, or about 2.5 percent of the annual mortality in the U.S. as a result of cancers from all known and unknown causes.

SITUATION	CAUSE OF DEATH
TRAVELING 700 MILES BY AIR	ACCIDENT
CROSSING THE OCEAN BY AIR	CANCER FROM COSMIC RAYS
TRAVELING 60 MILES BY AUTOMOBILE	ACCIDENT
VISITING FOR TWO MONTHS IN DENVER	CANCER FROM COSMIC RAYS
LIVING FOR TWO MONTHS IN A STONE BUILDING	CANCER FROM RADIOACTIVITY
WORKING FOR 1.5 WEEKS IN A TYPICAL FACTORY	ACCIDENT
WORKING FOR THREE HOURS IN A COAL MINE	ACCIDENT
SMOKING FROM ONE TO THREE CIGARETTES	CANCER, HEART-LUNG DISEASE
ROCK-CLIMBING FOR 1.5 MINUTES	ACCIDENT
20 MINUTES BEING A MAN AGED 60	MORTALITY FROM ALL CAUSES

RISK FROM RADIATION is compared with the risk from other situations or activities. In each case the risk is a one-in-a-million chance of dying as a result of the exposure. The illustration is based on work by E. E. Pochin in Britain and Richard Wilson of Harvard University.

studies of thyroid cancer following radiation therapy and from an association between prenatal irradiation and childhood cancer. In several independent studies the incidence of thyroid tumors has been recorded as increasing after treatment of the head and neck with X rays in childhood. Two of the studies showed the excess of tumors to be evident at doses to the thyroid as low as from .06 to .2 sievert.

The association between prenatal irradiation and childhood cancer may not be a causal one, but other causes for it have yet to be demonstrated. Taken at face value, the data imply that diagnostic X rays during intrauterine development may increase a child's risk of developing cancer before puberty by as much as 50 percent. Since the average dose in the circumstances is only from .01 to .05 sievert, the number of excess cancers suggests that the embryo and the fetus are relatively susceptible to the carcinogenic effects of radiation.

Although many other types of cancer have been observed to be increased in frequency in irradiated populations, the dose-incidence data for such cancers are generally limited. Nevertheless, the data indicate that the carcinogenic effects of a given dose are usually larger with high-transfer radiation than they are with low. They also indicate that the excess of cancers per unit dose varies appreciably among cancers at different sites in the body.

Analyses of the available data by groups studying the biological effects of ionizing radiation for the United Nations and the U.S. National Academy of Sciences have resulted in estimates that the total excess of cancers of all types is from four to 18 (from two to 10 of them fatal) per year per 10,000 people at risk per sievert, beginning some two to 10 years after whole-body irradiation and persisting thereafter for the remaining lifetime of the population at risk. The figures correspond to a cumulative lifetime excess of from 140 to 1,000 cancers (from 70 to 500 fatal ones) per 10,000 at risk per sievert.

These estimates have been criticized as understating the actual risk, possibly by a factor of 10, because they appear to neglect certain studies of populations exposed to low doses of radiation in which more cancers have been observed than could be predicted from the estimates. These studies have included workers at the nuclear plant in Hanford, Wash., nuclear workers at the naval shipyard in Portsmouth, N.H., military personnel exposed to atomic-weapons tests in Nevada, children downwind from a nuclear-test site in Utah and patients who had been given X rays in medical diagnosis.

Suffice it to say that none of the studies convincingly correlates the cancers in question with reliable estimates of radiation dose, nor does any of them adequately take into account the possible influence of exposure to cigarette smoke, drugs, industrial chemicals or other potentially confounding variables. In the opinion of most experts the studies therefore do not argue persuasively for increasing the present estimates of risk from radiation. Indeed, many experts see the present estimates as exaggerating the risk by failing to allow adequately for the repair of injury at low doses and low dose rates that has been observed in tumors induced in experimental animals.

With radiation of low linear energy transfer there are radiobiological grounds for expecting the risk per unit dose to decrease with decreasing dose and dose rate. In such instances, therefore, extrapolation by means of a linear nonthreshold model would tend to overestimate the risk of exposure to low levels of this radiation, and somewhat lower estimates would be in order. With radiation of high linear energy transfer, on the other hand, the data imply that the opposite may be true, since the carcinogenic effect of this radiation appears to increase with decreasing dose and dose rate.

Without a better understanding of the mechanisms of different forms of radiation-induced cancer any hypothetical dose-incidence model will probably be a gross oversimplification. With respect to doses that are in the range from intermediate to large, research on experimental animals indicates such doses may contribute to the risk of different cancers through diverse effects on endocrine balance, immunity, cell turnover and other physiological functions, with dose-incidence relations that can vary accordingly. Evidence that the dose-incidence relation may vary similarly among human cancers is provided by the data for skeletal tumors and for leukemia and breast cancer. Plotting the incidence on a graph yields similar curves for leukemia and breast cancer but a quite different curve for skeletal tumors.

Since the number of cancers attributable to low-level radiation in adults is small compared with the number attributable to other causes, any epidemiological study seeking to verify risk estimates for doses of from one to 50 millisieverts would have to include hundreds of thousands of subjects. Hence future efforts to refine human-risk estimates should not just rely on empirical observations but should include research into the mechanisms of carcinogenic effects in laboratory animals, cultured cells and other experimental systems.

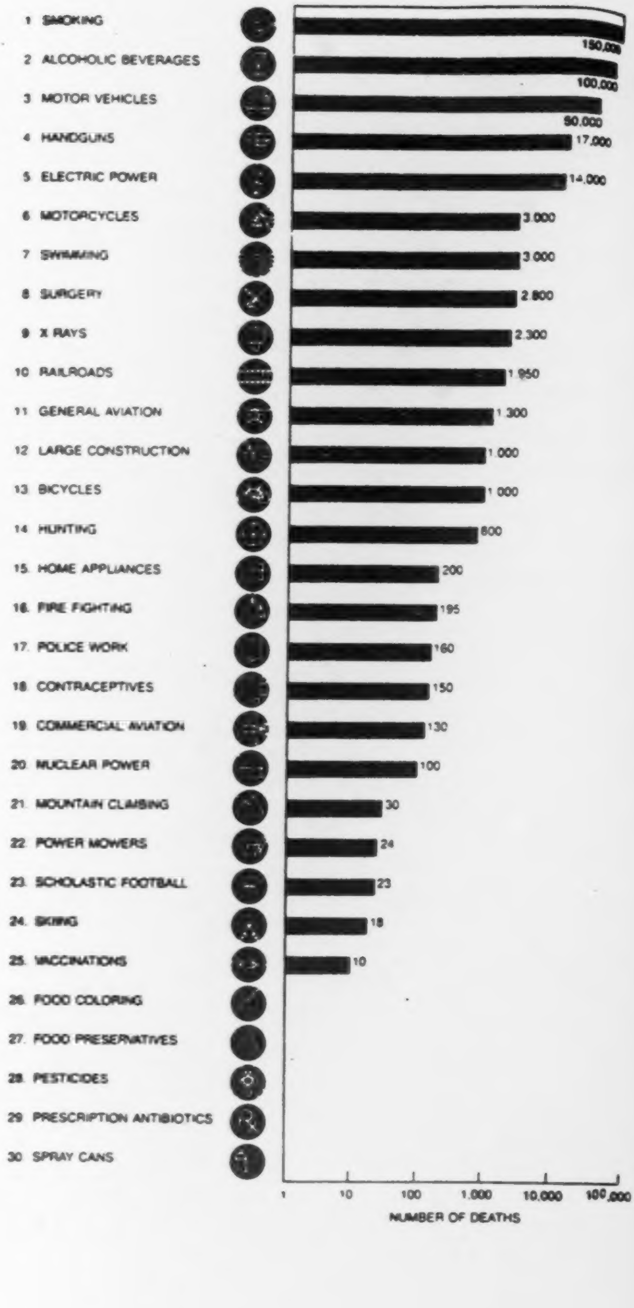
On the basis of the current risk estimates and on the assumption that risks vary as a linear nonthreshold function of the dose down to the level of the natural background radiation, it can be inferred that only a small fraction (from 1 to 3 percent) of all cancers in the general population are attributable to the natural background radiation. The inference is in consonance with empirical comparisons of cancer rates in geographic areas differing in background radiation levels. The estimates also imply that an appreciable fraction (perhaps 20 percent or more) of lung cancers in nonsmokers may be attributable to the inhalation of naturally occurring radioactive isotopes in the air.

The number of cancers attributable to occupational irradiation represents in most groups of radiation workers an increase of less than 1 percent over the natural incidence. Hence the average occupational risk to radiation workers, expressed in terms of life expectancy lost through carcinogenic and heritable effects combined, is comparable to the risk in occupations usually classified as being safe.

According to the view that no amount of radiation is entirely without effect, some risk must be presumed to be associated with any activity involving low-level irradiation, no matter how small the dose may be. Some such risks, compared with the other hazards of daily life, seem negligible [*see illustration on preceding page*]. Still, no risk can be regarded as acceptable if it is readily avoidable or if it is not accompanied by a commensurate benefit. In general the acceptability of a risk tends also to decrease to the extent that it is involuntary, particularly if it is imposed on those who do not share equitably in the related benefits. The weighing of risks and benefits calls for personal value judgments, which can vary widely among individuals.

Although the estimation of the health hazards arising from low-level radiation is a scientific problem, the acceptability of such hazards clearly depends on the perceived as well as the real magnitude of the risks and the associated benefits. Therefore the process of deciding about the acceptability of radiation hazards is one in which the society as a whole must be represented. Sound policy decisions will depend on public understanding of the issues as well as on the data provided by science.

Moreover, it is noteworthy that the problems encountered in evaluating the risks of low-level radiation are paralleled by similar problems in evaluating the risks of low-level exposure to toxic chemicals. The latter problems are even more complicated: they involve not only poorly defined variations among individuals and among species in the uptake, distribution, metabolism, detoxification and excretion of substances but also other sources of uncertainty. Nevertheless, the scientific bases for assessing the risks of radiation and chemicals are sufficiently similar for the concepts and principles derived from efforts to understand and protect against the biological effects of radiation to be helpful in developing strategies for protection against the health impact of toxic chemicals and other potentially harmful environmental agents.



PERCEPTION OF RISK varies widely among different groups of people. The chart at the right reflects a survey in which members of three groups were asked by Decision Research to rank the 30 sources of risk listed in the first column. There the sources are ranked according to their actual annual contribution to the number of deaths in the U.S. as they have been determined by actuarial estimates. That contribution appears in the second column; the remaining columns record the respective rankings by the three groups.

LEAGUE OF WOMEN VOTERS	COLLEGE STUDENTS	BUSINESS AND PROFESSIONAL CLUB MEMBERS
NUCLEAR POWER	NUCLEAR POWER	HANDGUNS
MOTOR VEHICLES	HANDGUNS	MOTORCYCLES
HANDGUNS	SMOKING	MOTOR VEHICLES
SMOKING	PESTICIDES	SMOKING
MOTORCYCLES	MOTOR VEHICLES	ALCOHOLIC BEVERAGES
ALCOHOLIC BEVERAGES	MOTORCYCLES	FIRE FIGHTING
GENERAL AVIATION	ALCOHOLIC BEVERAGES	POLICE WORK
POLICE WORK	POLICE WORK	NUCLEAR POWER
PESTICIDES	CONTRACEPTIVES	SURGERY
SURGERY	FIRE FIGHTING	HUNTING
FIRE FIGHTING	SURGERY	GENERAL AVIATION
LARGE CONSTRUCTION	FOOD PRESERVATIVES	MOUNTAIN CLIMBING
HUNTING	SPRAY CANS	LARGE CONSTRUCTION
SPRAY CANS	LARGE CONSTRUCTION	BICYCLES
MOUNTAIN CLIMBING	GENERAL AVIATION	PESTICIDES
BICYCLES	COMMERCIAL AVIATION	SKIING
COMMERCIAL AVIATION	X RAYS	SWIMMING
ELECTRIC POWER	HUNTING	COMMERCIAL AVIATION
SWIMMING	ELECTRIC POWER	ELECTRIC POWER
CONTRACEPTIVES	FOOD COLORING	RAILROADS
SKIING	PRESCRIPTION ANTIBIOTICS	SCHOLASTIC FOOTBALL
X RAYS	MOUNTAIN CLIMBING	CONTRACEPTIVES
SCHOLASTIC FOOTBALL	RAILROADS	SPRAY CANS
RAILROADS	BICYCLES	X RAYS
FOOD PRESERVATIVES	SKIING	POWER MOWERS
FOOD COLORING	SCHOLASTIC FOOTBALL	PRESCRIPTION ANTIBIOTICS
POWER MOWERS	HOME APPLIANCES	HOME APPLIANCES
PRESCRIPTION ANTIBIOTICS	POWER MOWERS	FOOD PRESERVATIVES
HOME APPLIANCES	VACCINATIONS	VACCINATIONS
VACCINATIONS	SWIMMING	FOOD COLORING

Senator SYMMS. Mr. Horan, what is the comparison of this kind of background radiation that you speak of in your testimony, with what, say, an airline pilot gets? Is that the same kind of radiation or is that different?

Mr. HORAN. We can make it equivalent. The equivalent exposure for a flight across the United States in a jet would be in the neighborhood of 4 to 5 millirem per trip.

Senator SYMMS. Four to five?

Mr. HORAN. That's right.

Senator SYMMS. So you go back, you might pick up, say, 10 on a round trip?

Mr. HORAN. On a round trip such as you would make back to Washington, yes. That is correct.

Senator SYMMS. So pilots, flight attendants, and others would get a considerably heavier dose than people that, say, even live in southeastern Idaho?

Mr. HORAN. That is correct. In fact, the NCRP, in one of their reports, considered that pilots and airline crews should be considered as radiation workers because of the amount of exposure that they receive.

Senator SYMMS. Is there any statistical evidence that they get more cancer than people that are in other fields?

Mr. HORAN. There could not be. And the reason I say that is, the population that is at risk, the number of people—I'm trying to think back to this NCRP report—I think the number of flight crew people in the United States is something in the range of 100,000. One could not statistically show an increase in cancer.

One of the figures that you might be interested in is this. A calculation has been made that to detect a 100 millirem per year exposure statistically, the increase in the cancer incidence rate based on what is known today, would require about 6 billion people in the sample population, and that is more than are living on the earth today. Incidentally, that was a statement in part of my testimony which I deleted in the interest of time.

Senator SYMMS. Okay, thank you.

Henry, I had a concerned constituent come to me, and I'm going to paraphrase what he said. He said, "Steve, if we don't get to the bottom of this thing and try to get a more careful consideration and risk assessment, the next thing will be that the EPA will have to start issuing orders and telling people that they shouldn't be allowed to fly across the country more than three or four times a year."

Do you, as one who is in the current Administration in an appointed position—does that concern you any? If we get involved in some of these things that are a little too esoteric, will we be trying to regulate how many times people fly across the country? Is that a fear that somebody out here in this audience should really have?

Mr. SCHILLING. I don't think that particular fear. I think it's absolutely crucial——

Senator SYMMS. If I felt we could keep the Congress all at home and not in Washington, I'd probably be for it. [Laughter.]

Mr. SCHILLING. It's absolutely crucial that we get clear understanding of the risks, as we understand them, as other members of the scientific community understand them, so that the public has a reasonable view about what the risks are that they are exposed to.

With respect to air travel versus radionuclides, we are governed by existing statutes which vary considerably in the kinds of problems they direct EPA to attend to, how to weigh various factors such as risk, jobs, economics in resolving those problems, and so on. I know of no authority that has been given us by the Congress to date that would have us regulating air travel, although I could be wrong on that point. I am aware of authorities that have us regulating air emissions, radionuclides, and the like.

So it's a little hard to compare them, in part because the statutes we administer address a disparate set of problems somewhat differently and it's hard to be consistent across all those problems.

Senator SYMMS. Well, this is very interesting. I would like to continue on this, but I see it's already 11:00 o'clock and I'm still just on the first panel. I'm supposed to be in Bancroft at 2:00, so I would like to thank all of these witnesses.

I thank all of you very much for your contributions.

Richard, I did have one question before we break this up. Hold up just a second. There's one question I wanted to ask the State.

Would the State of Idaho be ready to reduce the risk if it was determined that such action would benefit the public well-being?

Mr. SCHULTZ. Senator, I said yes to that in the statement. We'd certainly be willing to.

Senator SYMMS. Can you tell the committee what the State standard is for radiation exposure? That's the question I wanted to get on the record.

Mr. SCHULTZ. Okay. The current radiation standard is 500 millirems year, and that's in rules and regulations that have been in force since 1981.

Senator SYMMS. So that puts us well below the exposure here now?

Mr. SCHULTZ. In comparison to those standards, yes.

Senator SYMMS. And the standards here are what? How does that compare to EPA's study findings?

Mr. SCHULTZ. I believe EPA's study findings were, for the maximum exposed individual, in the range of 205 millirems.

Senator SYMMS. Okay.

I have some questions that I'm going to present to the State of Idaho Department of Transportation for the record, and ask them to reply to them about the State, why we have used road aggregate and so forth, which I think are important to have in the record also.[2]

Senator SYMMS. I want to thank all of you very much.

Admiral GUIMOND. May I make one final comment on guidelines?

Senator SYMMS. Certainly.

Admiral GUIMOND. In guidelines, both at State level, Federal level, and international organizations, we try to keep them up to date and try to take advantage of the best scientific information that comes out. Very recently the National Academy of Sciences under the leadership of Dr. Upton, whom you referred to, came out with a new report, and after reviewing the epidemiological work from Hiroshima and Nagasaki survivors, concluded that the risks may be higher than we had previously thought.

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[2] Replies not received by time of publication.

Right now, the international radiation protection organizations, the National Council on Radiation Protection, the Nuclear Regulatory Commission, and most of the other radiation protection organizations that I'm aware of throughout the world are recommending that we do not have people exposed—from all exposure sources that they would get that are man-involved, man-enhanced, or manmade—exceed 100 millirem per year. So as a consequence of that, I think you are seeing people trying to take a look at this health evidence, take a look at the strength of it. There are some changes that are moving in the direction of reducing maximum exposures because of that.

Senator SYMMS. I appreciate that. I think we all do, but everything is compared to what? If you remove the slag, then you have to replace it with something, and there are risks involved in that and there are costs involved. The bottom line is that we are well under what the standards of the State of Idaho are, and we are well under what is generally considered acceptable risk. To the two gentlemen from EPA, I appreciate your honesty in saying you felt that maybe there had been a mistake there. I think that's a statement we all appreciate so that we can put this thing in a proper perspective—as Senator McClure said in his statement, in a calm, unemotional judgment—to try to base our decision on science, not on some superstition that may or may not be relevant to the overall health of the community.

But I want to thank all of you—Mr. Horan?

Mr. HORAN. Senator, in honesty, may I add something for the record too?

The State regulations were originally written in about 1971. I was part of an ad hoc group that helped to write them. They are obsolete. They do need to be brought up to date. They are not in accord with current NCRP regulations.

Senator SYMMS. Okay. Thank you very much. I appreciate it, all of you.

The next panel to wait in the wings, so to speak, will consist of Mike Wood, Jim Morphey, and Suzanne Budge. They are invited to come over to this table.

And the panel that has been waiting in the wings consists of Peter Angstadt, Kirk Hansen, Bob Geddes, Denton Darrington, and Tom Katsilometes.

I want to first hear from the Honorable Peter Angstadt, the mayor of the largest municipality involved in the Idaho Radionuclide Study.

Mayor, from the city of Pocatello, we welcome you here to Soda Springs and look forward to hearing what you have to say.

STATEMENT OF HON. PETER J. ANGSTADT, MAYOR, CITY OF POCATELLO, ID

Mayor ANGSTADT. Thank you very much. I appreciate this opportunity to address some comments toward the EPA's Idaho Radionuclide Study with the subcommittee and the interested onlookers here.

I guess I am speaking somewhat for the city and citizens of Pocatello and the fact that they are extremely concerned about this issue. We want to be certain that the information developed, the conclusions reached, and the policies made as a result are as accurate and defensible as they possibly can be, because it is our economic well-being, our health, and our simple peace of mind that are at stake as a result.

I would like to say first of all that we do appreciate the EPA's interest in our area and the fact that they have studied it and their wanting to assist in making our area more healthy and desirable for our citizens. We also want to make our community a desirable place for our children and their children for many, many years to come. We don't take the concerns that are raised in the Idaho Radionuclide Study lightly and we want to cooperate in any way we possibly can to remedy any significant risks that may exist.

To start, however, we are concerned about the problems of the study and the conflict of opinion that has been raised in our community and in the scientific community. The first panel gives you a very good example of what we've been faced with for the past several months. We have a group of people who say it's a problem, and we have a group of people who say it isn't a problem. It seems that those of us in local government and the citizens we represent are caught in the middle.

The study has developed a worst-case scenario based on some hypotheses about maximum exposure. Because of the expense, it was limited to site-specific data. The data was adjusted by general ratios and regression equations, and some averages had to be used. The one thing that came out of all this is that our citizens now know that the EPA considers slag to pose a very high environmental risk.

But our citizens have also received very little information, without the controversy that has been generated, as I mentioned before, so that they can actually determine for themselves what this risk means to their family and their community.

We have some information from some groups—as you have seen, again, on panel one—that it isn't a problem. In fact, in our community there are some studies and some information going around that say that the actual studies of the workers who are regularly exposed to phosphorus and its byproducts show that these workers experience less cancer than the general population of the United States. The controversy exists, and that's just one example of it.

This certainly doesn't lend itself to any sort of confidence about the conclusions or what needs to be done as far as this situation goes. We in the city of Pocatello have banned the use of slag in present and future work projects, primarily because we had no information one way or the other. There was just too much controversy. The EPA had indicated to us that this would be the primary step that was the minimum necessary to avoid possible Federal intervention. If the threat of low-level radiation from phosphate slag is a real and definite one, we certainly do not begrudge taking these measures. We would rather err on the side of caution than anything else and for the safety of our citizens. But if the threat is not a real one, then our citizens are unnecessarily being exposed to an incredible turmoil of opinions, being deprived of the use of a construction material which is very cost-effective, and we are unnecessarily being faced with the specter of possible ill health and the costs of remediation of this problem.

We certainly want to do what's right for our citizens, and we don't know what is right. That's our main concern. It is our sincere hope that the results of this hearing and the discussions that result from this hearing will include the following:

One, an expeditious scientific peer review of the Idaho Radionuclide Study;

Two, a careful analysis of the actual disease experience in the study community and in the phosphorus industry as it relates to the risk assessment techniques of the EPA study in order to reconcile those two issues effectively;

Three, a consensus of opinion as to the actual health risks of slag in public works construction and the emission of radionuclides from the phosphorus plants in question. As I mentioned before, there still is not one opinion that we can follow, and right now, as I said, we're caught in the middle and it's very disconcerting; and

Four, if necessary, a reasonable remediation program that balances the economic realities of our areas with any recognized risks of phosphorus byproducts. One example of that would be the other day, when we were building our walkway at the airport, we found slag underneath the concrete. The question remains, do we remove it or don't we? We have no guidelines to work with. Again, we erred on the side of caution. We removed it.

I can assure you that I and the members of our City Council will do our utmost to assist in this process. Our concern is for our citizens, for their health, for our environment, and also for our business community.

I appreciate the opportunity to make our concerns known today. Thank you.

Senator Symms. Thank you very much, Mayor. I appreciate your dilemma, being in politics and having half your friends being for slag and half your friends against using slag. So you, as a local political leader, that leaves you with only one choice, and that's to speak for your friends. [Laughter.]

Mayor Angstadt. That's very true.

Senator Symms. Now, the Honorable Kirk Hansen, the Mayor of this good town, Soda Springs.

Mayor Hansen.

STATEMENT OF HON. KIRK L. HANSEN, MAYOR, CITY OF SODA SPRINGS, ID

Mayor Hansen. Thank you, Senator Symms, ladies and gentlemen, I am pleased to have the opportunity to testify this morning. First of all, on behalf of the host city I would like to welcome Senator Symms and those other individuals who are here with concerns for our city. We wish, however, that you were here to be fishing or hunting or enjoying the good weather that we have——

Senator Symms. So do I.

Mayor HANSEN [continuing]. Than the reason for which we are meeting.

However, I would like to take just a few moments and go on record with some concerns that we have with regard to past actions of EPA and the potential future actions of EPA.

Number one, and contrary to what was alluded to earlier this morning about the inactivity and unwillingness of local government to respond to the release of the preliminary study a year ago, I would like it to be known that the city of Soda Springs has cooperated 100 percent with the EPA. We allowed them free office space at city hall. We allowed them free power through our electrical system to run their air monitors. We had a gentleman's agreement with them that upon release of any information, that we as local officials would want to be apprised of that information prior to it being released publicly.

In 1989 there was a premature release of the preliminary report in Las Vegas, Nevada prior to us as local officials receiving the information. I subsequently sent a letter to the head of the EPA in Seattle and to Senator Symms and the other members of the Congressional delegation from the State of Idaho stating our disapproval of that.

I have to admit that EPA did make attempts at that time to repair the damage done and the public confidence that was eroded because of their actions. I have to admit that they have made an effort in that regard. I do compliment Mr. Mark Mazrek and Dan Phelan from EPA for their attitudes and the fact that they have been willing, as of late, to be very cooperative with us as public officials.

I have other concerns. Basically, one of them is the justification of an extensive amount of public money that has been expended in the Idaho Radionuclide Study. In the summer of 1989 when the preliminary report was released, it was reported by an EPA official that they saw no undue health risk in the use of slag. We were relieved at the same time that the release came out, even though it was premature, that they saw no undue health risk. That's what we thought at the time. However, in 1990 when the final results were released, all of a sudden there was a significant health risk, even though the study results had not changed in the intervening 12 months.

Needless to day, we received that as a "bombshell," so to speak, no pun intended. Certain statistics were released in the study that were not done—first and most importantly, the BEIR V report, the fact that the Academy of Sciences was quoted as being in support of the report which, as we know from testimony today, was not done. They told us that a health risk existed, but with no data to back up their assertion. We have been able to receive in our community other scientific information to show us that there is no undue health risk through the use of slag in the levels that we're discussing here.

Probably the most significant aspect that has come home to the citizens of Caribou County, and in particular the city of Soda Springs, is the following, that in their characteristic explanation of the health risk, "cancer" is the word that is used most often in their report. I would like it to be known that it is known now that of the 44 counties that exist in the great State of Idaho, Caribou County—which has been in the phosphorus business and the use of slag nearly 40 years—ranks number 44 out of 44 counties in the incidence of cancer. Now, if there is such a severe cancer risk through the use of slag, why does Caribou County rate last in the entire State? Likewise, we are one half the national average.

My question now is, What health risks really do exist if our cancer rates are half the national average and we rank 44 out of 44 counties in the State of Idaho?

I would think that people would want to be living in and moving to Soda Springs and Pocatello or they can live in areas that have health risks of these minimal numbers.

I think that in their release there was no real thought given to the emotional, the economic, or the total regional upheaval to what the final results did. I applaud Mayor Angstadt in his remarks in that regard. As a leader of a small community, and all of a sudden to have 4,000 people wondering what's going on with no back-up, you can hopefully appreciate the dilemma that we were in.

We in Soda Springs are in the developmental stages of developing a Citizens Advisory Board, and I need to let you know that this board will not be stacked. It will be 12 to 15 citizens of this city who will serve on this board to allow us, as local leaders and local citizens, the opportunity to review—with expert testimony from EPA and other interested parties—the results of the studies as they come and go.

EPA has said of late that they want to receive input of our concerns, and I appreciate their concern and their willingness to do so. But not wanting to be too obnoxious this morning, I would wish that they would listen to what we say. I have concerns that they say they want to listen, Senator, but of all the testimony that we have given them in the numerous meetings that we have had with them, I really wonder. They listen, but does anything happen?

Again I allude to the fact that there have been tremendous amounts of public funds spent on the study. And here we are, probably upwards of a million dollars having been spent, holding a Senate subcommittee meeting to ascertain whether or not what has been done has accomplished what was supposed to have been done. Obviously, the answer is no, so the money is going to continue to be spent.

I think the EPA, as any of us, is capable of error. If they have erred, I would want them to accept their responsibility.

Thank you, Senator.

Senator SYMMS. Thank you very much, Mayor.

I do want to wait until the end of the panel, but I just wanted to ask the Mayor one question.

What did the press release do to the value of the average homeowner in Soda Springs?

Mayor HANSEN. Senator, I'm not able to give you a specific number, but I would say that overnight the average value of a home, or any commercial property within the area of Soda Springs, had to take some drastic reduction in value.

Senator SYMMS. See, that's a problem that I think we can't emphasize enough to our friends in the regulatory agencies. There is a clause in the Constitution that protects people from taking, but environmental regulations have the ability to go in and take people's property and devalue it. They still keep it, but it reduces it value just by appearance sometimes. I think that's a real concern in risk communication, seeing the prices go down, on all kinds of agricultural commodities when nothing happened in reality. I think it's a serious problem that needs to be addressed and need to be listened to by those who represent those agencies and those in the Congress.

Thank you very much.

The next witness is a local gentleman, Bob Geddes, State Representative, and I understand you also have a statement on behalf of one of your colleagues.

STATEMENT OF HON. ROBERT C. GEDDES, A REPRESENTATIVE IN THE IDAHO HOUSE OF REPRESENTATIVES

Mr. GEDDES. I do, Mr. Chairman. Does that give me double time? [Laughter.]

Senator SYMMS. It doesn't give you double time, but we will put the statement in its entirety in the record and we would be glad to hear what you have to say, Bob.

Mr. GEDDES. Thank you, Senator Symms and members of the committee.

My name is Robert C. Geddes. I am a member of the Idaho House of Representatives, and for the last 14 years I have represented the citizens of Caribou, Franklin, Bear Lake, and Oneida Counties.

Representative John Tippets has asked me to read his testimony since he is out of the State on a legislative assignment.

I appreciate the opportunity you have granted me to appear before your prestigious committee. Prior to reading Representative Tippets' statement, please allow me to make a few comments of my own.

I totally concur with Representative Tippets' prepared statement. Furthermore, I am satisfied that the citizens of this community and the surrounding area, in overwhelming numbers and percentages, do not agree with the policy, methods, and assumptions that have been made by the EPA. Almost without exception the people in this area have sincere concerns about the consequences of actions that may result from EPA's decisions and policy.

Certainly, they are concerned about long-term health effects, but they are also concerned about what might happen to them if drastic action is taken by the EPA. They are concerned about a lifetime investment in their jobs. They are concerned about the lifetime sacrifice and investments they have made in their homes, recognizing that property values could be severely depreciated with unfavorable action of a heavy-handed Government agency.

May the record show that as an elected Representative of this district, I and my constituency are deeply concerned with the action of the EPA and do not find their action to be in the best interest of the people of this area, either from a health or an economic point of view.

Now please allow me to read the testimony of Representative Tippets.

Mr. Chairman and members of this committee, I am John Tippets and represent the citizens of this four-county area in the Idaho State Legislature. I would like to express my personal appreciation for your interest in investigating the matter at hand and add to it the appreciation of the residents of this area, who stand to be greatly affected by the decisions that will be made.

The technical and scientific aspects of this discussion will be addressed by others, far more qualified than myself. I would like to share my thoughts from the perspective of one who has been elected as a Representative of the residents of this area, and who has listened to some debate from those representing both sides of the issue.

A responsibility that I share with you as public servants is to see that the public health is safeguarded and that public funds are used in an efficient, effective, and responsible manner to carry out the necessary functions of Government. With that in mind, I have trouble understanding the position that the EPA has taken regarding the exposure of residents of this area to the slag that is produced locally.

It is my understanding that the average resident of Soda Springs is exposed to approximately 380 millirems per year of background radiation. The EPA is greatly concerned that approximately 52 millirems of this exposure comes from the slag which is produced locally and which has been utilized in certain construction applications in the area. This means that the slag-related exposure to the citizens of Soda Springs is less than one-seventh of the total background radiation.

I am sure you have heard, or will hear, the testimony that background radiation varies significantly from one area of our Nation to another, and that this additional exposure is within the range of variability which one could find in naturally-occurring background radiation, yet we are hearing discussions of removing and replacing concrete being used in basement foundations, and even the possibility of replacing the slag used in construction of roads and railways.

It doesn't take a Ph.D. in mathematics to realize that the cost of remediation could be astronomical if it is carried to this extreme extent. If there were a serious health threat, remediation would be the recommended course of action regardless of the cost. The fact is, the EPA has not proven—nor even presented persuasive evidence—that a significant health risk does exist.

Current guidelines which are in effect in this State and Nation as established by the Nuclear Regulatory Commission set the acceptable exposure rate for the general public at 500 millirems per year. Even with the alleged 52 additional millirems per year exposure resulting from slag, the average total exposure for the residents of Soda Springs is well below this established guideline.

I was very disappointed when I attended the briefing that was given by the EPA to learn that they could not tell us what they would accept as an acceptable exposure rate. We were told that they planned to monitor as many homes as possible in the area, and would then determine what is acceptable and what is not and what course of action should be taken.

If they are so convinced that there is a health risk, they ought to be able to tell us before the survey what it is and what is not an acceptable exposure rate.

It is very frustrating to me, as an elected official who is concerned with seeing that State tax money is used wisely and prudently and that the budget is balanced every year, to see the potential for waste in this project. It is very possible that a great deal of money could be spent here with little or possibly no benefit. When we look at the alleged risk and consider the small possible benefit of remediation, the ratio of money spent to the possible benefit looks very dismal at best.

I am sure that there are many ways these funds could be utilized that would provide some real benefit to the public.

I would like to just briefly address one other area of concern that I would not mention if I felt there was a real and significant risk to the public health, but under the circumstances I feel it is appropriate.

Some four years ago we saw the closing of a phosphate fertilizer plant in this area. We all gained a greater understanding of just how dependent we are on the phosphate industry in this two- or three-county area. In the one year's time that the facility was closed we witnessed a mass exodus from local communities. Real estate values plummeted. Many businesses closed. Unemployment skyrocketed, and many, many families were forced to reduce their standard of living dramatically.

When considering risks, I feel strongly that these issues should be given careful consideration as well. They are real and involve risks to the public well-being, as well as the obvious economic concerns. We still have not fully recovered from that one-year period, although it has been three years since the plant reopened.

We realize that if this issue was carried to a ridiculous extreme, we could see the same or a worse situation again. We could be willing to make these very difficult adjustments if we felt they were required to correct a significant problem.

As of today, I remain unconvinced that such a threat to the public health exists, and am disappointed with the methods which have been utilized by the EPA in dealing with the situation. I do not question the sincerity of EPA representatives, only their methods.

I hope that all of the facts can be examined from an objective point of view and that whatever course is taken, it will be one that accurately and efficiently deals with the situation rather than effectuating a gross overkill.

Once again, thank you for your time and effort in dealing with this issue of such importance to our area.

Mr. GEDDES. Thank you, Senator Symms.

Senator SYMMS. Thank you very much, Bob.

The next witness is the Chairman of the Idaho State Senate Committee on Judiciary and Rules, and is Vice Chairman of the Senate Health and Welfare Committee, Senator Denton Darrington from Declo.

Denton.

STATEMENT OF HON. DENTON C. DARRINGTON, MEMBER OF THE IDAHO STATE SENATE

Senator DARRINGTON. Thank you, Senator Symms. It is good to be in Soda Springs and be able to address this important problem today from the perspective of a southern Idaho farmboy. Every time I prepare testimony or material for a meeting such as this and try to apply some farmboy common sense to it, I meet with the agency people and find out there are too many shades of gray, that things don't work out the way it seems to me that they should. But I do have a statement to make.

We all know the importance of this industry to southeast Idaho, to Caribou County, and to Soda Springs. These plants produce essential products from some of the largest and most productive mines of phosphate in the world. With every mining operation and every industrial business, byproducts—that we commonly call waste—are generated, and that's unavoidable.

Because the phosphate in these mountains contains small amounts of uranium, there is a slight amount of radioactivity. We've had some discussion today with regard to millirems of exposure and so forth and the disagreement as to what is and what isn't, but by suggesting a disallowance in the use of the slag from the mills in roadbeds and building materials, is the EPA imposing a double standard? And is the standard one that is not backed by data or hard evidence, that the extremely low level of radioactivity has any significant or real health hazard?

If there is a health hazard, EPA should immediately come forth with the facts—not innuendoes, suppositions, or decisions that may be the result of pressure from anti-industry extremists in or out of the agency. If EPA can document a significant and real hazard, then what is the difference in the hazard in the use of the slag and in the hazard to the miners and the plant workers here in Soda Springs?

And, Senator, I don't think it's been addressed, but I think a question could be answered by some of the experts that there is a different standard in the workplace than the 500 standard that we accept in the State of Idaho. There is a much higher standard.

How many millirems of radioactivity do you receive from your car, your household appliances, your Coleman lamp mantle, or all the items with which you have daily contact? If the readings for these items are higher than the slag, why should their use not be disallowed if use of the slag is disallowed and discontinued?

Many families live in houses where the cement includes slag as aggregate. What do the preliminary EPA studies show? A Freedom of Information petition ought not be needed. The EPA should come right out and tell the citizens the results of the study every time they make one.

I suspect that the fact is that the study of the slag doesn't support the decision to recommend disallowance of its use.

The EPA or any other agency need not be involved in raising fears about use of slag or any other products without hard, conclusive evidence that a health risk is involved. Not only is that harmful to an industry, it also raises the specter of liability, and we are a litigious society, made more so by these kinds of scares.

I challenge EPA—and the Senate committee should demand—that the Environmental Protection Agency come forth immediately with a well-documented health hazard and apply the same standard for radioactive contamination that is applied to everything else, or give the slag a clean bill of health, permit its use, and even help find new and increased uses for this byproduct. No doubt many uses may come about that haven't even been thought of or discovered.

Senator Symms, what I am asking is that the agency be responsible, and that policy not be set according to the demands of radical extremists in the environmental movement.

I thank you, Senator, for the opportunity to testify, and good luck in demanding accountability on this slag issue from the agency.

Senator SYMMS. Thank you very much, Senator Darrington.

Finally on this panel we will hear from Bannock County Commissioner Tom Katsilometes.

Tom, we've got you at the other table, but you're still a part of this panel.

STATEMENT OF HON. TOM KATSILOMETES, COUNTY COMMISSIONER, BANNOCK COUNTY, ID

Mr. KATSILOMETES. Thank you. I feel a little bit like I'm being ostracized here from my other elected officials. Of course, in county government that's pretty much normal procedures, to have county commissioners split up, as some of my fellow county commissioners out here know. [Laughter.]

My name is Tom Katsilometes. It's just like it's spelled. I know you have to come to Idaho to learn a foreign language when you take one up, but it's just about like it's spelled.

I will be very brief and to the point. Senator Symms, I would like to thank you for your invitation to speak before you and the Subcommittee on Nuclear Regulation concerning the radiation levels in the slag that is a byproduct of refined phosphate at the FMC facility in the Pocatello area.

I am not here to argue the good or bad effects of these radiation levels. I will leave that to the experts on either side that have vast scientific knowledge of those radiation levels.

I would like to address the overall effect that this type of study and its release have on our area as a whole.

I don't know if anybody noticed, but Bannock County did not issue an ultimatum to our Road and Bridge Department to ban the use of slag. We feel that in following that lead we would only have been in a reactionary mode instead of systematically sifting through the evidence and then making a determination based on these facts.

We in Bannock County do not react to glitzy headlines designed to make us have a sudden reaction.

You will like this, Mike. With tongue in cheek, we thought about actually issuing an ultimatum stating that from this time forward, we were going to only use slag because the price was dropping off. [Laughter.]

As far as the slag itself is concerned, we have found that the slag presents a more fractured structure that allows for greater tire traction on wet or slippery roads. This greater traction increases the probability of saving lives. It is very often a much cleaner material, which allows greater bonding to the asphalt.

We feel that the EPA did overreact to this study. We find it of interest that their study took place more than three years ago, and only now their analysis comes out like gangbusters to put a scare into our citizenry and our mayors.

We think there is a problem with the manner in which the EPA handled this situation, but we also feel they aren't the only ones to blame. If the EPA has violated six of the seven "Cardinal Rules of Risk Communication," as you, Senator Symms, have indicated, then certainly the past Administration has violated a cardinal rule in providing protection to the citizenry of this country through the nonaction of the EPA for the past several years.

What we feel the EPA is now doing is overreacting to many environmental concerns that have been put in abeyance during the past Administration. We think the EPA has been neutered by the past Administration in trying to do their job, and now that it is politically popular to be an environmentalist, the present Administration has given the EPA free rein.

Because of this scenario, we feel the EPA may overreact to many other environmental problems, and this concerns us very much, as the real problem—as we see it—is that the EPA has been used for political gain by the past and present Administrations.

With all due respect, Senator, there is plenty of blame to go around. We think that some of the blame as to why we are even here today has to be laid at your doorstep and the Administrations, past and present, on the Federal level. We would like to have seen, Senator, you—as a sitting United States Senator on the Environment and Public Works Committee—take a leadership role in getting us some direction and giving some direction to the Administration in letting the EPA act as a reasonable voice for the protection of its citizenry.

Frankly, this entire scenario reminds me of an old Aretha Franklin song title, "Who's Zooming Who?" We don't need a political spin put on environmental issues that we at the local level now have to deal with because of the past misdirection that was given to the EPA.

Thank you.

Senator SYMMS. Thank you.

Bob Geddes, you mentioned that the local population has a generally negative opinion of EPA's actions in this area. For the record I would just like to know, did this attitude exist prior to the committee announcing this hearing here today, or since this hearing was announced?

Mr. GEDDES. Senator Symms, I would respond by saying that it is not just a new syndrome. I think it has been ongoing. I think we see compounding of this attitude with every announcement, whether it be Alar, whether it be something else. It just continues to question the respect for the EPA, in my opinion. Certainly, in this area I am sure that the citizens have responded to this concern, but I don't think it is necessarily the one that has created this thing.

Senator SYMMS. If that's not the case—in other words, if this hearing didn't have anything to do with the general attitude of the public—then do you think EPA should take that as an indication that their risk message is being misread or is not being accepted well by public opinion?

Mr. GEDDES. Well, Senator Symms, in this area with my constituency, I think yes, the interpretation of the EPA—the response that has come—would indicate that they are being misread. Not necessarily being misread, but they don't like the results of what they are hearing.

Senator SYMMS. You don't feel like there's a general feeling that the people don't want to shoot the messenger if they have a message that there really is a threat, but there's just that big skepticism about whether slag in the sidewalk is a big risk to anybody? Is that a fair statement?

Mr. GEDDES. Senator, that is a fair statement, in my opinion.

Senator SYMMS. And I guess what that begs for is what Senator Darrington called "a little common sense," is really all the public is asking for here?

Mr. GEDDES. Certainly.

Senator SYMMS. I wouldn't interpret this as anybody trying to put a political spin on it, as the Commissioner mentioned, but it is a matter of practical reality that we have an enormous Federal bureaucracy in this country, and that the people who own the houses and run the businesses in the private sector are the ones who take all the risks, and, if a press release goes out, the ones in the Government really have nothing to lose in terms of their own welfare, but the people out here really are the ones who are damaged by the actions of Government, and that's an improper role for a Federal regulatory agency to take. Would you agree with that?

Mr. GEDDES. Senator, I would agree, and I might just make a statement that will probably get me in trouble.

I think one message to the bureaucracy that the Government has got to learn is that it is just as painful to starve to death and to be driven from their homes because of the risk that may be there, as it is to die from some risk that we are talking about now.

Senator SYMMS. I hear what you're saying there.

Now, to the two Mayors, and I would just ask you each to comment briefly, would the Mayors consider the review of the Idaho

Radionuclide Study by the EPA Science Advisory Board to be of value in reconsidering the suspension? If you suspended the use of slag in both cities, would you consider the review of the Idaho Radionuclide Study by the EPA Science Advisory Board to be of value if you reconsidered that?

Mayor ANGSTADT. I think that's exactly what we're looking for, as much as we possibly can, a definitive review of that study. It seems we have enough scientific expertise on both sides of the issue that if a review were to take place, some sort of consensus or compromise on the valid points could be reached, and that would assist us in reviewing and redefining our procedural ways that we look at dealing with this problem.

Senator SYMMS. Do you feel the Idaho Radionuclide Study impacted you economically and psychologically? You both spoke to it. How much more money will it cost your roads and streets people to suspend the use of slag?

Mayor HANSEN. I'll address your latter question first, Senator.

We have a five-year plan within the city of Soda Springs for street maintenance. Because of the curtailment of slag—and the city of Soda Springs curtailed the use of it not because of the EPA results, but because it became unavailable to us and we had to go outside and try to find other sources of material——

Senator SYMMS. The company suspended the sale of it, then?

Mayor HANSEN. That's correct. So consequently you will see some streets that have been chipped in the city this year, but we had to curtail our chipping procedures over 33 percent because we did not have the available aggregate to use to do repair of the streets.

On your first question in regard to the Science Advisory Board's release, I think that's probably the real crux of the matter in a certain regard, because when the final results were released we were told that they had been reviewed.

So to answer your question, Senator, yes, I welcome the Science Advisory Board's review of the results, but I insert the previous comment that we thought that that had been done, and that's one of the reasons why we're so upset.

Thank you.

Senator SYMMS. Well, Senator Darrington, would a review of the Idaho Radionuclide Study by the EPA Science Advisory Board benefit the Idaho Legislature? And if so, how?

Senator DARRINGTON. The question has been raised today as to whether or not the State standard is an adequate standard. I suspect that that is one thing that could come under review by the Legislature and the Department of Health and Welfare, as to whether or not that standard is too high, too low, just right, or where it should be.

Senator SYMMS. Okay. Well, I thank you all very much. I appreciate all your testimony. You have contributed very much to this hearing.

Is Jim Morphey out here in the audience?

[No response.]

Senator SYMMS. The next panel consists of Mr. Mike Wood of Bannock Paving Company, and Ms. Suzanne Budge, Idaho Council on Industry and the Environment.

Mike, why don't we start out with you?

Mike owns Bannock Paving, a building contractor based in Pocatello, which is most heavily impacted by the decisions of the local governments, so he has had a direct hand in a lot of this. We look forward to hearing from you on.

To Mike and Suzanne, I've been advised that I need to step out of the room for just a minute, but I'll be close by. I will review your testimony. I am going to leave the two counsels here.

Mike, why don't you please go ahead? I'll be right back. Please continue on.

STATEMENT OF MIKE WOOD, PRESIDENT, BANNOCK PAVING, INC., POCATELLO, ID

Mr. Wood. Thank you, Senator Symms.

Senator Symms. The court reporter has requested that witnesses, as they speak, identify themselves each time during the question period. I guess he had a little trouble with one of the panels.

I don't think you'll have any trouble between Mike and Suzanne here. [Laughter.]

But that was for the past panels.

Go ahead, Mike.

Mr. Wood. Thank you, Senator Symms.

My name is Mike Wood. I am President of Bannock Paving Company of Pocatello, Idaho. I appreciate the opportunity to address the committee today and discuss the uses of slag as a viable aggregate for use in construction.

I am not here to speak about the scientific aspects of slag or the radiation, but I do have some experience in the use of slag as a roadbuilding material.

Our company employs between 150 and 250 people per year, and we have an annual payroll of over $6 million. Since 1969 Bannock Paving has crushed and marketed slag to various users throughout southeastern Idaho, including the State of Idaho, most cities and counties, and private users. Our largest customer, the Union Pacific Railroad, has distributed slag in most of the western States they operate in over the past 20 years.

Over the past 20 years we have processed and sold over 12 million tons of slag for use in area streets, highways, parking lots, and as ballast for the railroad. In my experience I can safely say that slag is by far the best material available for their uses, and that's based on cost. There is very little waste when you are processing the material, and it can all be made into viable products. It doesn't entail any drilling or blasting or hauling costs. The material comes directly from FMC's furnaces, which makes it a very reasonably-priced material.

The performance of the slag is very durable. As has been alluded to earlier, it is fractured material, very angular, and stays in place, requiring less maintenance than round river rock.

It easily meets the specifications for railroad ballast, and the railroad has been very pleased with its performance in their grades.

In terms of impact on southeast Idaho, my entire payroll of $6 million and the families which that supports, not to mention the

State taxes paid from that income, are probably all in jeopardy. Also, we have 500,000 tons of processed slag on hand at the present time with no place to sell it.

Also, on the railroad ballast, there are no viable alternatives for the ballast. There are no quarries in this vicinity with trackage that could be found to produce new ballast.

Alternative sources for highway and road aggregates are also expensive to locate and develop in terms of quality, efficiency, and productivity. Also, there are environmental costs associated with their development.

I would ask the committee to consider the devastating impact that any restrictions on the use of slag will mean to me and all of my employees, and to consider the benefit to residents and taxpayers of southeast Idaho that the use of slag represents.

Thank you very much.

Senator **SYMMS**. Suzanne.

STATEMENT OF SUZANNE BUDGE, EXECUTIVE DIRECTOR, IDAHO COUNCIL ON INDUSTRY AND THE ENVIRONMENT

Ms. **BUDGE**. Thank you for the opportunity to speak today. My name is Suzanne Budge. My written testimony has been submitted in full. I am the Executive Director for the Idaho Council on Industry and the Environment. The Council is a member-based organization representing over 100 individuals, associations, and businesses who are committed to reasonable and rational solutions to Idaho's environmental challenges.

As a native Idahoan who was raised and educated in Soda Springs, and a geologist by profession, I would like to comment today on the slag issue.

The Council is very concerned with four aspects of the EPA's recently-released study. These are all things you've heard before today, but I'm going to repeat them.

Number one is the assessment, or lack thereof, of actual health risks of slag exposure; the manner in which the study was brought to the public; lack of full and free access to the raw data, the models used, and the assumptions made by the EPA; and lack of thorough peer review. I am going to expand briefly on each of those comments.

First, the actual health risks associated with slag exposure remain somewhat in question, as is obvious by previous testimony this morning. EPA estimates average exposure—and this is all from the paper; EPA has not supplied numbers in their fact sheets—an average exposure of 52 millirems a year. Compared with already-established national standards, 52 millirems is one-tenth of the guidelines set by the U.S. Nuclear Regulatory Commission, and one one-hundredth of the guidelines set by OSHA for workplace exposure.

With regard to naturally-occurring exposure, as we've heard today, populations are exposed naturally to 300 to 375 millirems; 85 percent of that is natural. In fact, moving from Washington, D.C. to Soda Springs, Idaho will increase annual radiation exposure by more than 50 millirems per year simply due to increases in elevation.

I guess my question at this point would be whether the EPA can propose to relocate entire populations of Idaho to sea level in order to eliminate that kind of a risk. As a native of Soda Springs myself, I think I would probably defer moving to Washington, D.C. due to risks other than those possible from radiation exposure.

In light of natural exposure levels several times higher than EPA's estimate, and previously established national standards from ten to a hundred times higher, Mr. Chairman, our question is whether slag exposure is indeed a significant health risk at all.

Our second concern is with the manner in which EPA represented its findings. As you have heard this morning, over a year ago the EPA discounted radiation from slag as being insignificant; yet in its recent announcement, the EPA study found "levels of radiation exposure that could cause significant health risks for some individuals." Obviously, there is quite a discrepancy between the initial analysis of the report and the final press release.

To further complicate that kind of a scenario, dramatic language is widespread in the EPA's own literature, and I'm going to give you a few quotes out of their fact sheets.

EPA considers the situation to be "quite serious." Long-term exposure to slag constitutes "a definite health risk." Slag-contaminated foundations are "the greatest single contributor to individual health risks." And EPA considers slag to pose "very high environmental health risks."

As a person who works professionally on risk communication and actual environmental risks, this leads me to assume that slag exposure must rank up there with really significant health risks, such as cigarette smoking, alcohol, and motor vehicles, which literally account for hundreds of thousands of deaths each year. If that is EPA's message, it is certainly, at best, very misleading.

Our third concern is with access to raw data, the models used, and most importantly, probably, the assumptions made by the EPA. The agency is apparently unwilling to release its information to either the public, the companies involved, or the State of Idaho officials.

We would like to know how the EPA's "ball park estimates," also a quote from their fact sheets, fit into the bigger picture so we can have an understanding of what that means in the real world. What is the risk of slag exposure when compared with other risks we face and accept every day? That kind of information really ought to be available in light of the kind of risks they're advancing here. And when it is not available, I have to assume that the study will not withstand scrutiny of independent peer review.

That leads me to my fourth comment. I would like to mention the necessity for independent peer review, and based on some comments made earlier, I'm going to stress that from my perspective that means a peer review of the actual numbers and the study, not a peer review of the protocol, and not a simple briefing to the Science Advisory Board.

All statements and assessments made by the EPA should stand the scrutiny of a review process that is simply routine in any scientific field, and certainly, any health risk study naturally requires a thorough peer review by experts who are independent of the EPA.

Senator Symms, this entire scenario calls into question the credibility of the EPA. It brings an undue panic, and possibly a dire economic consequence, to the residents of my home, southeastern Idaho; and perhaps most seriously, it diverts badly needed resources away from the very issues in this country that pose genuine health risks.

Mr. Chairman, I appreciate the opportunity to comment today, and I also would like to thank you all for coming to Soda Springs to listen to our comments.

Senator SYMMS. Well, thank you very much, Suzanne. As I have said, I think that anything less than a congressional hearing on behalf of the people in this area, the interested parties, and the regulatory agency that is involved would, in my view, be less than what the people in this part of Idaho deserve. I think that this should not be viewed as something that's political. What I'm trying to find out is what the scientific basis is, and that we act in this country based on sound science and not on superstition, so that the people can in fact enjoy the benefits of confidence that they are living in as safe and clean an environment as they can.

Trent, you said you had a question that you want to ask Mike? I have a couple that I want to ask also, but go ahead.

Mr. CLARK. Thank you, Senator. It's not often that the staff gets to do anything more than just sit and watch.

As a staff person on the committee, one of the things I've been most concerned about is the fact that when EPA made their initial release of information, there was a complete absence of any information about the health benefits of the use of phosphate slag. Now, the National Academy of Sciences in its Guidelines for Adequate Risk Communication, makes an entire section of its guidelines on communicating the potential benefits.

The agency may have done that just assuming that there are no health benefits, but I went back and looked at some of the actuarial statistics that we have and found that something as small as a 2 to 3 percent increase in road surface safety would in fact save a lot more lives than the lives that would theoretically be at risk from the use of phosphate slag. Therefore, if the agency just arbitrarily goes out and says, "Ban the use of phosphate slag," without looking at whether or not there might be some potential benefits to its use, it may in fact be advocating killing more people than we save. That's the whole objective of getting accurate risk communication out, so that the agency isn't killing more people than it saves.

Your testimony was the first time that I, as a congressional staff person, have ever seen any information on the potential benefits of the use of slag as a roadbuilding material. Could you tell the committee, in your opinion might there be somewhere in the realm of a 2 to 3 percent increase in road surface safety, either because it's more economical and therefore you can repair more roads, or because of the things you mentioned, just about the nature of slag as a fill material itself? Might there be a 2 to 3 percent increase in road surface safety?

Mr. WOOD. There could be. The one use of the slag in that case would be the seal coating. As Commissioner Katsilometes alluded to, it does present a very skid-resistant surface. The State of Idaho and most of our users seem to agree with that.

Mr. CLARK. Okay. Thank you.

Senator SYMMS. Mike, in road and fill business, what do you do if you don't have this slag? Do you have to go out and open up the mines and the quarries to get the rock and do the blasting and do the drilling and all that?

Mr. WOOD. In our case, we would have to open up some farm ground and go through a zoning process, environmental impact, and reclamation plans. It would take some valuable farmland out of service, when we have this unlimited supply of slag available.

That is our alternative, but at what cost, we don't know. It's going to be at great cost to relocate and try to find an alternative source, in our case.

Senator SYMMS. You mentioned no drilling, no blasting, or hauling costs. That is of considerable importance, then?

Mr. WOOD. Yes. We could never produce the quality of material out of a rock quarry or out of a river gravel source.

Senator SYMMS. So given that FMC has suspended the sale of slag, what is your alternative now? Are you in the process of doing this or, are you hoping that they are going to restore sales?

Mr. WOOD. Naturally, I'm hoping they will restore sales. We are exploring the possibility of relocating to other sources. One of the big problems now is the 500,000 tons of processed slag I have on hand right now that I probably won't be able to market unless things change.

Senator SYMMS. Well, I think that's of considerable importance. I am sorry that Jim Morphey is not here.

Jim is a well-known real estate developer in the area.

I might just ask the two of you, from your knowledge of this, being in business and associated with business people, what has been the impact on the real estate markets in southeastern Idaho as a result of this?

Mr. WOOD. It has undoubtedly hurt the markets. I am sure that the communities that don't use slag are using that as a weapon. I have heard that Idaho Falls uses that as a weapon against Pocatello as a viable place to live, making hay with that. But I'm sure it has had to have hurt the markets because of all the publicity it has received.

Senator SYMMS. Suzanne, I am sure that you have talked with people here, having been raised here. What is your feeling on the real estate impact?

Ms. BUDGE. Well, I think people are quite concerned. Having been raised here and having gone through three or four downtrends in the industry, as Bob Geddes referred to, I think there is significant concern, and a fair amount of outrage from the local people I've talked to.

I would like to comment very briefly if I could, Senator, on two environmental concerns that I have that are really spinoffs to your question. One is that the current move in this country today is to minimize wastestreams and to try to utilize the three Rs—reuse, recycle, reduce. The use of slag is actually a classic example of trying to utilize a wastestream for something beneficial, so it actually goes along with a lot of the EPA's current thinking and that of the State of Idaho in utilizing a wastestream that would otherwise be piling up.

The other impact on which I have concern from the environmental point of view besides the wastestream is just the impact of having to replace slag as a source of material. As Mr. Wood said, obviously, if you have to replace that much aggregate, you're going to have to do it by mining, by impacting the forests, or other private or public land, in an undoubtedly negative way.

Senator SYMMS. Thank you both very much. We appreciate it.

The next panel consists of radiation risk experts coming from industry. We have Dr. Warner North from FOCUS, Incorporated; Dr. Herman Cember from Northwestern University; Dr. John Auxier, Corporate Manager of Nuclear Sciences for International Technology Corporation, and Dr. Pat Conners from Monsanto Company.

First we are going to hear from Dr. Warner North, who is the Principal of Decision Focus, Inc., as well as a faculty member at Stanford University. Dr. North, with academic training in physics, has done extensive consulting and research on environmental risk issues, including risk assessment, risk management, and risk communication. He is coauthor of "Improving Risk Communication," a National Academy of Sciences publication. Since 1979 he has been a member of committees of the Science Advisory Board in the U.S. Environmental Protection Agency.

Dr. North.

STATEMENT OF D. WARNER NORTH, DECISION FOCUS, INC.

Mr. NORTH. Thank you, Mr. Chairman.

Senator SYMMS. Thank you for being here.

Mr. NORTH. I might clarify at the outset that I have served since 1982 on the Environmental Health Committee of the EPA Science Advisory Board. Since 1985 I have been the Vice Chair. Dr. Arthur Upton of the New York University Institute of Medicine, whose name has come up several times before in this hearing, is the Chair of that committee. But I have not been involved, ever, in the Radiation Advisory Committee, whose review of the work plan has been discussed earlier.

As you summarized in your introduction, my field is environmental risk assessment, management, and communication, and I will discuss these aspects of EPA's Idaho Radionuclide Study.

My appearance in this hearing is sponsored by the FMC Corporation. I have never been employed by FMC, nor have I previously consulted to or testified on behalf of FMC. The statement that I present is my own and should not be interpreted as reflecting the position of FMC or any other organization with which I am now or have been associated.

The theme of my statement is the need for improving risk communication and getting on with the process of risk management—deciding what to do about phosphate slag. In my judgment the EPA study, the fact sheet, and the press release on the study present a distorted picture that omits important scientific uncertainties on the health impacts of low doses of ionizing radiation.

EPA's estimate of an increased cancer risk from slag is theoretical. As the other speakers on this panel will indicate, there is no observational evidence that low doses of ionizing radiation lead to any increase in the incidence of human cancer. The calculations that EPA has made of increased cancer risk are based on an extrapolation of the cancer incidence from high doses of radiation, such as those experienced by survivors of the nuclear bombings in Japan, to a prediction of a small increase in cancer incidence from low doses of radiation. The increased radiation from exposure to slag in Soda Springs and Pocatello is within the range of variability of background radiation from cosmic rays, for which exposure varies with altitude, and naturally-occurring minerals that contain low levels of uranium. The predicted changes in cancer incidence are too small to be observable in health studies.

EPA's 1986 "Guidelines for Carcinogen Risk Assessment" described a risk estimate, sometimes referred to as a "unit risk," as "a plausible upper limit to the risk that is consistent with some models of carcinogenesis". Such an estimate, however, does not necessarily give a realistic prediction of the risk. The true value of the risk is unknown, and may be as low as zero. The range of risk, defined by the upper limit given by the chosen model and the lower limit, which may be as low as zero, should be explicitly stated.

The statements of the probability of contracting cancer due to exposure to phosphate slag in the foreword, the statement of findings, the main text, and the tables of the Idaho Radionuclide Study consistently violate EPA's own guidelines. EPA's risk results should be restated, that the increased cancer risk could be as low as zero and as high as the numbers that have been calculated.

In other respects, as well, the EPA report and the press release do a poor job of communicating about risks. One statement in EPA's May 31st news release seems particularly egregious: "Long-term exposure to slag constitutes a definite health problem. We believe that the future use of slag in roads and construction should be banned." It is misleading to state that radiation exposure from slag constitutes a definite health problem. There is no observational evidence that the radiation levels present in Pocatello or Soda Springs induce cancer in humans. A second problem is that EPA has advocated a risk management policy; banning the future use of slag in roads and construction. For at least some construction uses, the human exposure will be so low that the risk is clearly inconsequential, even using EPA's risk estimates.

The National Academy of Sciences report, "Improving Risk Communication," of which I am a co-author, provides a number of applicable conclusions and recommendations. I will briefly mention five points. Citations to the Academy report are given in the written version of my statement.

First, EPA's report neglects the uncertainty in estimating the low dose impacts of ionizing radiation on human cancer. The assumed linear relation between radiation dose and cancer incidence is stated in one sentence, on page 36 of the EPA report, without citation to authoritative sources such as the National Academy of Sciences' "Reports on the Biological Effects of Ionizing Radiation." The foreword to the EPA report notes that if the recently-released BEIR V calculations are used, the estimated cancer increase would be approximately doubled. It is also noted in the foreword that the phosphorus industry in Idaho is too recent for lifetime exposures to have occurred, so that the cancer risks today are overestimated.

The reader might get the erroneous impression that all the important caveats have been provided. To the contrary, EPA has not mentioned many sources of uncertainty and has not summarized other appropriate caveats. In a report of nearly 50 pages, EPA should spend at least a page informing the reader of the uncertainties in the projection of cancer incidence from low level exposures to radiation.

Point two, EPA should have worked with Idaho agencies and the interested parties in the local community in preparation of the report. EPA prepared a detailed analysis of risk and presented it to the affected parties with little opportunity for them to participate on the goals, scope, and content. EPA has expressed its intention to work with Idaho agencies and the affected parties in Soda Springs and Pocatello to deal with the slag issue. EPA should deliver on this promise and practice risk communication as an interactive process.

Three, EPA should have had its risk assessment peer-reviewed. In particular, the raw data from the surveys of Soda Springs and Pocatello should have been made available for scrutiny and review prior to publication in a formal report. Peer review of EPA's report was alleged, but all the EPA Science Advisory Board's Radiation Advisory Committee did was to review a work plan. As will be noted in the testimony of subsequent speakers, there appear to be a number of technical flaws in EPA's work. "Improving Risk Communication" strongly advocates the use of independent peer review.

Four, EPA's report provided very little information on the risk management context. "Improving Risk Communication" notes that the goal of risk communication is to achieve well-informed decisions, and it devotes a section to ensuring completeness in the risk communication process, including a risk message checklist. EPA's report deals incompletely with the first category on this checklist, the nature of the hazard, and ignores the subsequent categories: the nature of benefits; the alternatives; the uncertainties in knowledge about risk; and information on management. EPA should do much more to provide information to the affected communities regarding risk management for slag.

Fifth and last, are the risks posed by radiation from slag acceptable? It seems to me that this determination should be made by local people who are given the opportunity to become well-informed about the level of radiation from slag and the health consequences of this radiation. Experts from EPA, Idaho State agencies, the academic community, and Idaho industry might all contribute to helping the public become better informed about this issue.

Thank you.

Senator SYMMS. Thank you very much, Dr. North, for an excellent statement.

The next witness is Dr. Herman Cember. He is Professor of Environmental Health at Northwestern University. Dr. Cember studied health physics under a fellowship from the National Research Council and received a doctorate in biophysics. He has spent his career teaching and researching health physics and radiation bioeffects, and has served on several State and national committees, including EPA's Environmental Radiation Advisory Committee.

Doctor, I look forward to your testimony.

STATEMENT OF HERMAN CEMBER, PROFESSOR OF ENVIRONMENTAL HEALTH, NORTHWESTERN UNIVERSITY

Mr. Cember. Thank you, Senator Symms.

The main points that I wish to make in this presentation are, one, that risk assessment itself is a highly subjective, theoretical, mathematical exercise that inherently contains numerous uncertainties; and, number two, that the EPA's risk analysis notwithstanding, every bit of real data that we have on health effects from radiation shows that there are no health risks associated with the radiation doses that we experience in Soda Springs and Pocatello.

Risk assessment deals with the estimation of the probability of occurrence of an unlikely event, and it consists of two processes. One is risk estimation, and two is risk evaluation. In risk estimation we determine the odds for the chances of the occurrence of this unlikely event, and in risk evaluation we try to figure out what this estimated risk means in the context of other risks that we, either as individuals or as a society, face.

Risk evaluation or assessment is not intended to predict the number of deaths following a specific low exposure. It is intended to serve as a guide for public policy decisions on the allocation of resources.

In the case of environmental radiation, the estimation of risk seems to be objective and scientific since it is based on laboratory studies and on epidemiological data. The evaluation of risk is a lot more subjective, however, and it includes societal and personal values as well as numerical probabilities. For example, death or serious injuries from traffic accidents seem to be acceptable to society and are considered to be one of the normal risks of everyday life. We also perceive the death of a child from cancer differently from that of a 70-year-old cancer victim.

Although we perceive the risk assessment process as being objective, there are in fact a number of uncertainties and subjective decisions that enter into the risk assessment process. These uncertainties include the very validity of the model chosen for extrapolation from high doses and high dose rates, as is done in the case of radiation, to low doses and low dose rates. Extrapolation from animal species to humans and consideration of other factors may influence the outcome of a given exposure, such as smoking, for example.

An enormous amount of data are available for radiation risk estimation. Contrary to the widespread popular belief that we know little about the effects of ionizing radiation, we probably know more about the effects of ionizing radiation than about the effects about any other harmful agent to which we may be exposed.

The Japanese and American group of scientists and physicians who are studying the survivors of the nuclear bombings in Japan to date have found no increase in leukemia among survivors whose doses did not exceed 10,000 millirems. Recall that the average exposure, according to the EPA estimates, are 52 millirems in Soda Springs and 14 millirems per year in Pocatello. Because we have no data whatsoever from any other sources showing that radiation exposure at these low levels leads to an increased probability of cancer, we resort to mathematical techniques for extrapolating the cancer dose response relationship to doses less than 10,000 millirems. Remember, we have no evidence showing that cancer occurs below 10,000.

An alternative to extrapolating lower doses is simply to say that there is a threshold of 10,000 millirems, and that the risk below this dose is zero. However, regulatory agencies do not do this because the most conservative biological models for cellular changes that may lead to cancer assume that even a single hit on the DNA molecule can start the series of events that ultimately leads to a cancer. For this reason, a zero threshold linear dose response model for cancer production is postulated, and it is assumed according to this model that any exposure, no matter how small, carries with it some proportional risk.

I must emphasize here again that we have no biological evidence to verify these assumptions. According to this model, the EPA risk calculation shows that the maximally exposed individual in Soda Springs occurs an additional risk of six chances in 1,000 of dying from cancer as a result of his or her exposure. They go on to define the maximally exposed individual in the EPA calculations as "a teenager who spends most of his or her time over a 70-year period in the basement of a home, the foundation of which is made of slag."

If we consider all the people in Soda Springs rather than this maximally-exposed teenager, then the EPA calculation postulates 0.1 cancer deaths per year; that is, one additional cancer death every 10 years among the 3,800 inhabitants of Soda Springs. This is based on assuming an average dose of 52 millirems per year to this entire population.

The doses under discussion in the cases of Soda Springs and Pocatello populations are within the range of variation of the background radiation in the United States and in other countries of the world. Background radiation includes contributions from cosmic radiation, whose intensity varies according to the altitude and according to the latitude, and terrestrial radiation from naturally-occurring radioactive materials whose intensity varies according to the mineral content in the ground. A person in Chicago, for example, receives an annual dose of about 100 millirems from this background, while a person in Denver receives a dose of about 200 millirems in one year in background. We have never found any leukemia or any other type of cancer among any population anywhere that could be attributed to increased background radiation.

Other groups of people who may serve as a yardstick in evaluating the health effects of the radiation levels found in Soda Springs and in Pocatello include radiation workers. A number of studies involving many thousands of radiation workers have shown that the observed cancer rate is about 85 percent of the cancer rate that would be expected on the basis of cancer rates generally in the population. And this, of course, controls through age distribution and so on. The radiation doses to these workers—that is, the occupationally-exposed workers—are on the order of hundreds of millirems per year.

The findings to date are consistent with the observation that doses on the order of background variability do not result in an increase in the cancer rate. The BEIR Committee of the National Resource Council, in their Report No. 5, explicitly recognized this by saying, "Thus, the possibility that there may be no risks from exposures comparable to external natural background radiation cannot be ruled out. At such low doses and dose rates, it must be acknowledge that the lower limit of the range of uncertainty in the risk estimates extends to zero."

In summary, I believe that the population doses in Soda Springs and Pocatello are so low that they do not pose any health threats to the population.

Thank you, Mr. Chairman.

Senator SYMMS. Thank you very much, Doctor, for your statement.

Doctor John A. Auxier is the corporate manager of nuclear sciences for the I.T. Corporation and the author of numerous publications on the health effects of radiation exposure. He has served as a consultant on the issue to many Government bodies, including the Safety Advisory for Three Mile Island, Unit 2; the National Academy of Sciences on Energy Management; and as a member of the Dose Assessment Steering Group, U.S. Department of Energy. He is the past president of the Health Physics Society and president-elect of the American Academy of Health Physics.

Doctor Auxier, welcome to Soda Springs.

STATEMENT OF JOHN A. AUXIER, CORPORATE MANAGER OF NUCLEAR SCIENCES, INTERNATIONAL TECHNOLOGY CORP.

Mr. AUXIER. Thank you, Senator Symms.

Ionizing radiation can be harmful and is a known carcinogen at high doses and dose rates. Ionizing radiation is part of our natural environment and is not known to be harmful at or near environmental levels. In fact, all of the large bodies of data available indicate that dose levels up to at least 10 times the average natural background levels are not harmful. For the levels under discussion, it is noteworthy that the National Council on Radiation Protection and Measurement stated in a recent NCRP report, No. 93, that dose reduction "would not be feasible or cost-effective in the case of building materials or mining and agricultural products."

The BEIR V Committee relied to an unprecedented extent on a single exposure situation, the survivors of the bombings of Hiroshima and Nagasaki. While this data base is unquestionably the most important single set of information available, exclusive reliance on this one study leaves the committee's findings overly vulnerable to errors or omissions in its dosimetry or epidemiology.

For example, the BEIR V Committee noted that extensive experimental and human data indicated that doses delivered slowly had less effect than doses delivered instantaneously. This has been known for more than 50 years, yet the BEIR V model is based on high doses delivered instantaneously. The committee noted that the low dose rate data showed reduction in the effectiveness of the radiation to do harm by a factor of 2 to 10, but this factor does not appear in its conclusions.

In my opinion, it is unfortunate that the BEIR V Committee did not place greater emphasis on data from studies of other exposure groups that more closely relate to the low dose/low dose rate situation we are now considering. I believe it is appropriate to consider risk estimates derived from BEIR III as well as those derived from BEIR V, at least until such time as some of the current controversies surrounding BEIR V are resolved.

The BEIR V Committee stated that the uncertainty in their model was 25 percent, with zero risk as a possible consequence at low doses. This can apply only if the model applies, but all evidence at low doses indicates that the BEIR V model does not apply and that the risks are, indeed, zero. The committee concluded that the model did not preclude a threshhold level of effects below which the risk is zero.

As you have heard, the variation in the natural gamma radiation background is quite large, ranging from as low as 30 millirems in some coastal regions, to over 5,000 millirems per year in an area of Brazil. In Kerala, India, there is a region with a population of about 100,000 people in which the doses range from about 300 millirems per year to 2,800 millirems per year, with an area-wide average of 500 millirems per year. In this population the Indian Government has reported longer life span, fewer cancers, and higher fertility than in the socioeconomically-equivalent population nearby.

The exposure to background radiation is an involuntary risk, if a risk exists. A person concerned about this risk could lower the risk by actively lowering the background radiation, most readily by moving to a low background area. The public is usually concerned about involuntary risks that are imposed by others, while often accepting higher risks because they are voluntary. An involuntary risk could be pollution from a factory, while a voluntary risk might be the choice of not wearing seat belts while driving a car, or even driving a car. The use of slag in construction as surfacing material could be a voluntary risk, since the availability and cost make them desirable compared to mining and long-distance transport.

The total risk of using slag may be less than that of an alternative material, since the radiation risk is zero or nearly zero.

Figure 1 shows some actual annual radiation exposure rates and three proposed or adopted limits for exposure to the general population. The natural background external radiation rates span an order of magnitude from approximately 50 millirems per year for U.S. coastal plain locations, to 500 millirems per year for the average resident of Kerala. This rate, Kerala, also happens to be the exposure limit above background for the general population currently in force in this country, which is one-tenth the limit for radiation workers, in whom we see no increase in cancer, even 45 years after the time of highest exposures in major Government facilities.

In some surveyed areas, such as Denver, the external background averages about 90 millirems per year higher than in the coastal plain. This difference is illustrated by the bar labeled "Denver Increment." This increment is only a little less than the NCRP-91 recommended limit of 100 millirems per year to the general population. Language specifying limits "above natural background" not withstanding, the body has no way to distinguish between background radiation and radiation due to technological activities. Clearly, NCRP-91 goes about as far as we can go without being scientifically inconsistent, economically foolish, or perhaps both.

The average exposures reported for Soda Springs in the Idaho Radionuclide Study are also presented in Figure 1. Taking those numbers for the moment as reported, we see first that the average net exposure is about half that of the Denver Increment, while the rate on driveways is only a little higher than that increment. The average net first floor exposure rate is a bit less than the average natural background in the U.S. coastal plain and considerably less than that of the Denver area. It should be noted that the gamma ray exposure rate in some well-known public structures, such as New York's Pennsylvania Station, is several hundreds of millirems per year. In recent measurements in the Rotunda of our Nation's Capitol, the average is 115 millirems per year. Now, this is just gamma rays, such as we're talking about here. And similar measurements in EPA headquarters at the Mall Entrance averaged 46 millirems per year.

Although assigning risk to categories of voluntary or involuntary can be subjective and open to debate, I have attempted to use this mechanism in Figure 2 where it can be seen that risks to citizens of Pocatello and Soda Springs are tiny compared to other common risks, even using the values computed by EPA based on the BEIR V model.

Another difficulty with the risk estimations before us is that they were so dependent on aerial measurements. These measurements were well done, but have the disadvantage of averaging over a wide area because of the very nature of such measurements—and, I might add, the specific nature of the materials used in paving materials. This averaging results in a higher-than-actual average over any given area by a factor of 2 or more. Ground-based measurements show clearly that the dose rate falls off quickly as one moves away from an area paved with slag-bearing materials, and we've done this. This lowers the already-low risk estimates and assures us that the doses are within the variable range of normal background radiation in this region.

The risks to the populations of Pocatello and Soda Springs due to the radioactivity in slag are, in my opinion, zero. Actions to reduce exposure from construction and surfacing materials are not warranted. Discontinuation of their use is not recommended, especially if other materials increase the risk to the population through transport and mining risks.

Other social and economic benefits should be considered before discontinuation is recommended.

The conclusion of NCRP-93 should be heeded, that dose reduction "would not be feasible or cost-effective in the case of building materials or mining and agricultural products."

Again, I appreciate the chance to discuss this with you, Senator. Thank you.

Senator SYMMS. Thank you very much, Dr. Auxier. I will have some questions a little later.

Our next witness is Dr. Pat Conners, a medical doctor with Monsanto. He is a diplomate of the American Board of Medical Examiners, American Board of Internal Medicine, Assistant Professor of Medicine at St. Louis University, and has worked for a number of firms in occupational health.

Dr. Conners, we are glad to have you here today.

STATEMENT OF PATRICK R. CONNER, M.D., THE MONSANTO COMPANY

Dr. CONNER. Thank you, Senator Symms. I want to thank you for this opportunity to more fully discuss a number of issues which have caused the public great concern and great anxiety over the past few months, issues which go beyond mathematical formulas and look at real effects on real people. My presentation is aimed at providing facts which I hope everyone concerned will find helpful in assessing the questions surrounding the issue of whether or not the presence of elemental phosphorus slag in the communities of Pocatello and Soda Springs presents a significant risk to the future health of the citizens of both of these communities.

You have already heard a great deal about risk assessment procedures and radiation protection practices, their proper use, and—unfortunately—their occasional misuse. I would like to provide you information on what we have been able to measure about the human health effects of low-level exposures such as we are talking about in this case.

You have probably already heard that both cities and the counties in which they reside have low cancer rates compared to the rest of the country. Since EPA is expressing its greatest concern for the exposures in Soda Springs, I would like to present figures specifically for Caribou County.

You will note in this first chart that the Caribou County statistics, which are represented by open bars, are lower than the national average for every decade, and lower than the State average for almost each one of these periods. In fact, during the period 1980 to 1987, the most recently available figures, the Caribou County cancer mortality rate is about half the national average, and actually appears to be falling.

The second chart provides information on leukemia. Leukemia is the malignancy that was most clearly and most closely associated with radiation exposures from the atomic bombs at Hiroshima and Nagasaki. Please note that EPA is primarily extrapolating from this one-time, extremely high dose event to come up with its risk assessments in southeastern Idaho.

Leukemia may serve as a sentinel malignancy because it was the first malignancy to show up, and its incidence peaked within 10 years of the bombs being dropped. Again, I believe you will notice that the leukemia rates for Caribou County are declining, and for 1980 to 1987 appear to be about half the State and national leukemia rates.

Slag has been sold by FMC and Monsanto in both of these communities since the early 1960s. If exposure to radiation from slag in either of these cities was causing a major increase in leukemia, that effect would be showing on this chart by now. Actually, as you can see for yourselves, just the opposite is the case.

Let's move on and see what epidemiology has been able to show us in more highly exposed populations.

FMC has been examining its own workforce for more than a decade as a part of its occupational health program. The most recent study covers all employees who worked at their plant in Pocatello for at least one year between the years 1949 and 1987. This is an extensive study, including more than 1,900 individuals, with a total of more than 18,800 person-years of exposure to work in the plant.

The investigation's most striking finding is that cancer rates in these FMC employees do not increase with increasing length of employment. You certainly would expect the opposite to be the case if exposure to slag were causing cancer in this occupationally-exposed population.

An even larger and more significant study was published last year by a group of prominent epidemiologists who investigated three Federal nuclear weapons facilities. The study involved almost 36,000 workers with over 700,000 person- years of exposure. Cumulative doses in this study ranged from zero to well over 20,000 millirems. The average exposure to this very large study population was 3,100 millirems. The average length of follow-up in two of these plants was 21 years, and in the remaining plant was a still considerable 14 years. Remember, these lengths of follow-up are important because it takes time for cancer to develop, but leukemia developed in the atom bomb victims in less than 10 years, or at least the peak of its incidence did.

In this case, not only was no increase in total cancer rate detected, but there was actually a slight decrease with increasing cumulative dose. The same held true for leukemia. Again, the trend for leukemia rates with increasing dose in this huge study population was negative; that is, a slight decrease in the rate of development of leukemia with increasing cumulate dose of radiation. I might also add that the size of this study population is almost 10 times the total population of Caribou County.

Mother Nature provides us with further clues. Naturally- occurring variations in background radiation do not appear to affect the cancer rates in human populations. One particularly relevant study compared aerial study data—just as in the Idaho Radionuclide Study—of the entire State of Connecticut with the world's best data on cancer incidence in humans, the Connecticut Tumor Registry. It turns out that cancer rates in Connecticut do not vary in relation to levels of background radiation. This negative finding is particularly significant, since this State in general has a high level of background radioactivity, and the variation across this State is doubled. I've forgotten the exact numbers, but the lowest town and the highest town are a factor of 2 apart.

The bottom line is that the available evidence on humans does not demonstrate adverse health effects at the dose levels we are talking about in Soda Springs and Pocatello from exposure to slag.

To summarize, I would like to point out that the risk figures EPA has broadcast are only hypothetical projections. They are not scientifically-measured facts. Meanwhile, the absolute fact is that such estimates have a range of uncertainty around them.

Another fact is that the true risk from exposure to the radioactivity in slag in both communities may be zero.

Senator Symms I must stress that any action that EPA proposes carries psychological, sociological, and medical costs, even when a benefit to its actions is clear and demonstrable. In this case, EPA itself has repeatedly stated that it will never be able to measure the benefit they have hypothesized.

Meanwhile, the citizens of Soda Springs and Pocatello have clearly and eloquently—I'm afraid more eloquently than I have today—expressed the harm that they fear from the agency's pronouncements that they and their neighbors are at an increased risk of dying from cancer.

Senator, the ultimate ethical maxim in the practice of medicine is "Above all, do no harm." I implore the Environmental Protection Agency to follow that adage. They must act as responsible and effective physicians for the environmental health of all of us, omitting nothing that impacts the welfare of these communities from their consideration.

That is the end of my statement, Senator. I thank you again for the time.

Senator SYMMS. Thank you for a very powerful statement.

I am a layman, as many in this room are. One wonders, when we hear two sides of an argument presented, what we are supposed to believe. It seems very clear to me, but Dr. Conner, in your statement—and all of you, basically—are saying that it is zero risk. Is that basically what you said?

Dr. CONNER. To be absolutely accurate, the risk is so small we can't measure it.

Senator SYMMS. So I think we all basically would agree with this statement, that we never want to get in a position where we want shoot the messenger. We want to hear the message, whatever it is, and then go from there.

Have you worked with EPA on this issue prior to all this coming out?

Dr. CONNER. I personally have not, within Monsanto. Other parts of Monsanto have. I don't know how closely they've worked. Certainly, our experience is no better than that which Mayor Hansen described, and I think very similar.

Senator SYMMS. How about some of the rest of you?

Yes, Dr. North.

Mr. NORTH. Having been a member of committees of the EPA's Science Advisory Board for more than a decade and having participated in the SAB review of the carcinogen risk assessment guidelines that I quoted from, I might try to explain the process that EPA uses in health risk assessments on chemicals, and on radiation as well.

There is a process for calculating a plausible upper bound number, using a linear model which has as its basis some models of the process of carcinogenesis. In other words, we are making some assumptions about what the biology is, and we really don't have direct knowledge to verify those assumptions.

We would then go through and make those calculations, and those are the numbers that EPA used, and with BEIR V that calculation has been somewhat revised based on redoing the dosimetry from the Japan bombs.

So I would not want to go so far as to say that the calculation that EPA made is totally wrong. Rather, my concern with it, which I have set forth in my statement, is that they didn't include the caveats that their own guidelines say that they ought to include, and this has been an issue on many Science Advisory Board reviews that I have participated in on health risk assessment documents. The committees that I have been on have insisted that those caveats be appropriately reflected in the public document.

Dr. CONNER. I just wanted to respond to one thing that you mentioned just a minute ago, Senator, and which you mentioned previously, which I think is very important.

I can certainly speak for Monsanto in this case. No, Monsanto definitely does not want to shoot the messenger.

Senator SYMMS. Well, I don't either. I want to get this thing laid out on the table, but I certainly——

Dr. CONNER. The point I wanted to make is, Monsanto needs——

Senator SYMMS. If somebody from Mars were to walk in here and hear you gentlemen talk, with all your expertise, they might come to that conclusion, but that's not the conclusion I want to come to.

Dr. CONNER. What we need—trust of EPA has been mentioned before—we need a Federal agency that the public can count on, that they can have faith in, that they can go to and have the questions answered like the questions that Mayor Angstadt from Pocatello had. The public needs those questions. Industry needs those questions, because it is no news to anyone in this room—yourself, or anyone who is involved in this case—that there is radioactivity in this slag. There is a health question about that. Whether or not EPA ever came into these communities, that's a question that is there. It is a question that affects Monsanto, it's a question that affects FMC, and it affects our ability to do business in these communities.

Right now we are really not sure what we can do. It greatly impacts our ability to do business. We need an effective and trusted EPA that does good work, that doesn't go out and make up their own rules and do science by their own rules without observing the way things are done around the world. I'm afraid that is what has happened in this case.

Senator SYMMS. I guess where I feel in a little bit of a dilemma, and I'm sure people in the audience do also, this morning Mr. Findley said that EPA firmly believes that "scientific evidence supporting elevated risk to individuals in southeastern Idaho due to slag is clear and convincing."

Now, you've all just said that that's not true.

Mr. AUXIER. What he is saying, accurately, is that if we apply the models that we're using, the mathematical extrapolation, then he is correct and no one would argue with him. The fact is that the models are subject to international debate, and the reason that they are subject to international debate is that the model flies directly in the face of all of our known human experience on radiation effects at low levels. Not only is there no observed deleterious effect, but as you notice from all the statements and the things you see on the board, the high background areas of the world have a lower cancer incidence rate than average. So there's nothing wrong with their position as regulators, to take a given model and extrapolate from that model with the proper caveats and tell people that's the situation, but in reality they need to know — everyone needs to know, EPA needs to tell everybody—that on the other hand, in human experience, which is very broad and deep, we have seen no detrimental effects at these levels. That's the one statement that is missing everywhere.

I have been involved in the ICRP, the NCRP, I'm on the Council now, and we've gone through all the debates on these various arguments. We always end up by saying, "We want to protect human health, so we're going to extrapolate this linear thing down to zero dose." And up until recently, the idea was that we would pick some level that we considered as an acceptable risk, like the risk equivalent to working a year in a safe industry, one of the safer industries. And that's how we set the dose limits previously. That's still the way they're supposed to be set. But if we forget that that linear model was developed for the express purpose of providing protection to people and switch it over to use it for epidemiology and calculating risks, then that is scientifically invalid without the statement that we're using the model, recognizing that we've never seen effects down here, and indeed, that there is a lot of evidence to say that they do not exist. There are several studies in which there is a threshhold at very high doses, known zero effect below very high doses. We don't know it for this kind of radiation at this level, so to be on the safe side we use the linear models. But we've never seen an effect, and when you start turning people's lives upside down, you'd like to have it based on something more than a model that is in international dispute.

Senator SYMMS. Dr. Auxier, I found this fascinating, about the peanut butter and the two cigarettes a day. Are you saying that if you take the BEIR III test, then eating four tablespoons of peanut butter per day would be about like living in Soda Springs?

Mr. AUXIER. Yes, sir, and I'm glad you asked about that. That is the same kind of argument that we should use about radiation. We know more about the effects of radiation on the human being than any other deleterious agent. The second most, and approximately the same, is cigarette smoking, and there are a few other agents about which we know the risk coefficients pretty well.

Peanut butter, saccharine, lots of these things have been observed in laboratory animals only, and therefore—the peanut butter thing, I was hoping someone would ask about it—that is one of these hypothetical risks that we don't know exist. And as a matter of fact, we certainly would not ask people to not eat peanut butter——

Senator SYMMS. But if you look up at the top of your chart there, you've got the two cigarettes per day, which are much, much higher than any of these other factors.

Mr. AUXIER. And that's a good, solid number. That one, we don't have to hand-wave about. We've got lots of data on the effects of cigarettes. If you take the risk of so many packs and divide it up, then one or two cigarettes per day gets on the chart pretty easily, and it's also a very small number. But that's a good, solid number. That's not hand-waving. That's not hypothetical. We know that cigarette smoking extrapolates——

Senator SYMMS. Well, is that actually based on two per day, or is that based on somebody who smokes 40 per day and then you extrapolate it down?

Mr. AUXIER. A superb question, sir.

Senator SYMMS. I've always been told that if you have one or two, it wouldn't be nearly as bad for you as if you smoked 40 per day.

Mr. AUXIER. Perfect. Perfect. That's true. One or two is not as bad as eight or ten or twelve, but we see that with the smoking experience we've got four-pack-a-day smokers, three, two, one, and people who claim they only smoke a few a day. And it plots a nice curve. In this case, the extrapolation is based on hard data, and therefore the two cigarettes a day—I have no doubt that that's a good number.

Senator SYMMS. That's fascinating. I find it very interesting.

Have any of you seen the SAB review of the proposed research protocol for the Idaho Radionuclide Study?

Mr. NORTH. I have seen it and reviewed it briefly.

Senator SYMMS. In your opinion, did the EPA fully incorporate the suggested changes?

Mr. NORTH. It's too hard for me to tell at this point, because what I did not see was the information that was presented to that SAB committee. Typically, when the SAB committee meets it is a public meeting and there is a great deal of guidance provided to the agency, in addition to the formal report that is prepared. All I have seen is the formal report, and it only makes a couple of points. The EPA Administrator wrote back to the Science Advisory Board, describing how the agency proposed to respond to those particular points.

It is my impression that as this issue was presented to the SAB, the focus was on estimates of radiation exposure. I did not find mention of the projection of cancer risk in reviewing the SAB report of October 9, 1987 and the Administrator's letters in response of October 30, 1987 and December 15, 1987.

Senator SYMMS. Well, while we have our hearing record open, I would be interested if any of you did review that. If you have any thoughts on it, you could send a letter to the committee. I think that would be interesting to add to our record, and it might also be helpful for the agency.

Dr. CONNER. If I may respond briefly to something you had asked just previously, why the difference—we have four people here who are saying "it's not a big problem," and we have EPA saying "it's a big problem," and why the difference?

If I may—and I hope Dr. North and the other members of the panel stop me short if I misquote them—one of the main differences, if not the main difference, between what we are presenting to you today, sir, and what the EPA has sent to the community is a difference of omission. What they have omitted in their writing, particularly their public communications, are things like the lack of uncertainty, the range that is around the number.

They've even gotten down to the point where I'm afraid they have omitted some important things from even just simple numbers that they've used. I happen to have a copy of a document that Dr. Guimond quoted earlier today. We experienced this previously at the public meeting at the Junior High School in June. Dr. Guimond, and earlier Mr. Leach from Region X, quoted a public upper exposure limit of 100 millirems per year, net exposure increase from the actions of humans to the general population. And that, indeed, is correct and it's right from NCRP Report No. 91. As a matter of fact, that's chapter 17

However, sir, chapter 18 is a whole chapter on remedial action levels for members of the public. This was never mentioned. I think it's most important. Quite specifically, if I may quote directly—this is on page 41, for the record — "When the average annual effective dose equivalent from external exposure, excluding medical but including naturally- occurring sources, continuously exceeds 500 millirems, remediation is to be begun."

In other words this body, the international body, its partner the ICRP, all repeatedly recognized a very real difference between stopping the use of something to begin with and going in and tearing up people's homes, their streets, their cities, their lives. They say that over and over again, and that has never been communicated, nor have I personally been able to find any sense of that in the communication from EPA, which I think is at the root of a lot of what a number of us are talking about today.

Senator SYMMS. I think that you precisely put your finger on why it is important to have a congressional hearing on this subject; so that we and the agency and the public that is affected can try to reach some kind of a conclusion of what might be a practical solution to a problem, or a perceived problem.

Any other comments that any of you had? Yes, Dr. Cember?

Mr. CEMBER. Yes. I would just like to bring out an analogy to what Dr. Conners just read.

The 100 millirems per year that the NCRP and the 500 millirems per year for remediation are analogous to cutting the grass. We cut the grass when it is about four or five inches tall, and we cut it down to one inch. I think that's exactly the analogy that applies to the case of taking remedial action when it exceeds 500 millirems per year, and getting it down to the 100 millirems per year.

Senator SYMMS. In other words, you're saying that maybe not using slag in the future, if that were a scientific conclusion after all the studies are done, would be one thing, but tearing up the basement or tearing up the street would be a different thing.

Mr. CEMBER. That's precisely what I'm saying, yes.

Senator SYMMS. Okay.

Well, gentlemen, I would like to hear more of this, but unfortunately we still have some more witnesses here, and I would like to hear from them, too.

So thank you all very much and thank you for your efforts to be here.

We have some public witnesses. I would like to call them forward. We have room for four at each table.

We have Tom Bernasek of FMC; Kent Lott of Monsanto; Jim Yost, Idaho Farm Bureau; Ed Tracey; Sam Horton; Dave Sanna—

and let's see, John, do we have others that have signed up?— Bob Skinner.

We've got about three minutes apiece, if you can make it short and to the point, so let's just start right off. Who is first here? Tom?

STATEMENT OF TOM BERNASEK, GENERAL OPERATING SUPERINTENDENT, FMC CORP. POCATELLO, ID

Mr. Bernasek. Thank you, Senator. I would be happy to be first. In the interest of time, I will be very brief.

Mr. Chairman, I am Tom Bernasek, manager of FMC's Pocatello plant. Our plant has been in operation, as stated several times today, for over 40 years. We have a long history as a responsible corporate citizen in our community.

This morning we have heard a lot of very technical information concerning the potential health risk of exposure to slag. I personally don't mind admitting to you that I didn't understand everything that the health physicists told us, and I'm quite sure that I'm not alone in that arena.

However, what is very clear to me is that there is a lot of uncertainty about the conclusions of EPA's report— uncertainty, first of all, about the amount of radiation as a result of slag; uncertainty about what that amount means in terms of risk; and uncertainty about what should be done, if indeed anything, in response to the report.

FMC is committed to the safety and well-being of our employees and the community where we operate. You heard Dr. Conners cite the facts about the health of FMC workers. Through the Medical College of Wisconsin we regularly conduct epidemiology studies on current and former Pocatello employees to determine if our plant operations are having any impact on health. Over 40 years of date say that not only are our employees demonstrating no unusual incidences of disease, but they are in fact below the national average in rates of cancer.

Given that these are the people that work most closely with slag, that makes a pretty strong case, I believe, for saying that there is no impact from it.

I speak not only as an FMC employee but also as a citizen and property owner in Pocatello when I thank you for affording this opportunity to raise questions and express concern about this EPA report, which does indeed stand to have a dramatic impact on Pocatello and Soda Springs communities, as well as our operation.

FMC stands ready to work with EPA, with the State, and with community officials to assure that further assessments of exposure and risk are as accurate as possible.

Senator Symms. Thank you very much, Tom.

Kent Lott, Technical Superintendent of Monsanto Industrial Chemical Company.

Kent.

STATEMENT OF KENT LOTT, TECHNICAL SUPERINTENDENT, MONSANTO INDUSTRIAL CHEMICAL CO.

Mr. Lott. Thank you, Senator.

Monsanto has been in operation in Soda Springs for the last 38 years, as has been mentioned. During that period of time we have tried to be good citizens in the community. Our plant and corporate policy centers around our number one priority, and that number one priority is the safety and health of our employees and our neighbors.

I have been employed at the plant for 24 years, much of that time working on environmental issues. Our practice has been to apply the latest and best technology available in addressing environmental concerns. I believe that we have established a very good reputation in the community and among State and Federal regulators as being environmentally responsible.

We believe that exposure to radiation at the low levels present in our slag does not pose a health threat to the community. This belief is supported by sound epidemiological data, testimony of mainstream health physicists, and national and international guidelines, as you've heard this morning.

We are very concerned about the EPA report on radiation and the manner in which it was communicated. In its fact sheet, the agency admitted that the risk estimates were based on unproven assumptions, yet their public statements say that there is a definite health risk associated with the use of slag. As you've heard today, reputable scientists of national and international stature say that there very well may be no risk at all.

EPA in its communications has raised the specter of drastic action in our communities. There are surely significant psychological and social impacts associated with such action.

In view of the fact that there may be no risk at all, and the dramatically favorable health statistics for southeast Idaho and Caribou County in particular, the entire issue needs to be opened up to the full light of scientific and public scrutiny. Because this issue may have regional and national impact, there needs to be complete and thorough review by the Science Advisory Board. EPA has committed to submit their proposed action levels and further testing plans to the public for review and comment, and we applaud this. There must be significant involvement by the community in making the final decisions as to what actions, if any, need to be taken.

Finally, let me stress that we want to get the answers out also in order to reassure our community that there is no health problem posed by the slag already in the community. We must stress that we believe our slag poses no health risk. However, we will support the EPA study, and we certainly encourage proper scientific review and public opportunity to review and comment.

Thank you.

Senator SYMMS. Thank you very much, Kent.

Jim Yost, Idaho Farm Bureau.

STATEMENT OF JIM YOST, IDAHO FARM BUREAU

Mr. YOST. Yes, Senator. I appreciate the opportunity to be here.

Some may think it strange that the Farm Bureau would want to present certain remarks on this subject, but the Farm Bureau has had much experience in similar areas, dealing basically with Alar and Aldecar. Those two studies or reports also came out of EPA. We compare this study as another attack on an industry without scientific evidence and study, especially with the study that is suspect. Dr. Conners and others have testified here today that the EPA's report is not a health threat, and some of those do disagree with EPA's report.

We feel it is important that Farm Bureau members and citizens in the community are provided with an accurate assessment of the particular situation. We feel that the risk-benefit analysis is flawed and not realistic. We do, however, support a scientific study. We want that scientific study to have a scientific review, and we want a valid risk- benefit analysis of that study and of the situation concerning the use of slag in the communities and in Idaho.

We also feel that perhaps EPA was unduly motivated by a $2 million fund for remediation, that that glittering carrot may have been more than what the bureaucracy of an agency could attest to, and that they felt that they needed to have a place to clean up, so they looked at Soda Springs.

We also feel that Region 10 employees may have been overzealous in this slag issue because of their retaliatory attitude toward Idaho because of past actions of the former Region 10 Director from Idaho. We would like to have those things brought to light. We are very concerned about that agency.

The Farm Bureau does support the scientific study. We would like that information communicated to the citizens of Idaho.

Thank you for the opportunity to speak.

Senator SYMMS. Thank you very much, Jim.

Sam Horton from Horton Concrete Construction—excuse me, what's your name?

Mr. SANNA. David Sanna.

Senator SYMMS. Oh, David Sanna. Excuse me, David. I guess Sam Horton is not there.

STATEMENT OF DAVID SANNA, POCATELLO, ID

Mr. SANNA. Thank you, Senator. I will try to keep my comments brief, although my involvement with EPA has been a very long and drawn-out involvement.

My purpose in testifying before you today is not to provide you with technical information with respect to the problems of slag radiation. Scientists making presentations today have probably adequately articulated their opinions regarding the risk or the lack thereof, of radiation emitted by slag.

This testimony is designed to give you a first-hand account as a result of a CERCLA action of how the Environmental Protection Agency, designed to protect us against environmental disaster and remediate the problems created by environmental abuse, has actually been ineffective in its charge. At worst the agency, in our case, has obstructed reasonable efforts at obtaining solutions to problems, and has perhaps even violated our rights in the process.

In March 1983 my wife, Dana McCarty Sanna, became a defendant in a CERCLA action. We actually came home from a ski trip to discover, in our reading of a local newspaper, that she had been named as a defendant. I emphasize that she had not had any prior contact with EPA. We literally read of her involvement in the Idaho State Journal—this, despite the EPA's own procedures require that landowners or other potentially responsible parties be given the opportunity to clean up hazardous chemicals or other elements that pose a threat to public safety.

My wife was and is a landowner as a result of inheriting the land from her late husband, who had inherited the land from his parents. Could EPA have contacted my wife and properly advised her of her potential responsibility? Most definitely, yes. This point is crucial because in the beginning EPA must have thought they were going to be able to pressure other defendants, with whom they had tussled before, into some kind of remedial action. By drawing at the other defendants, Pacific Hide and Fur and Idaho Power, into the case, they literally tied up all of McCarty's, Incorporated assets, which could have been used in a potential settlement.

At the outset, the agency conducted an emergency response on the site. Initial tests indicated that there was PCB contamination on the site, but that the contamination was isolated to a few hot spots near leaking capacitors that had been discarded on the property. Early tests that showed that there was ground water contamination were totally erroneous. Contaminants have never been detected in the ground water.

The point here is that in the beginning, the possibility of a reasonable settlement that all of the defendants was a real possibility. At this time, estimates of the cost of remediation were somewhere in the neighborhood of $2 million, probably not more than that. Unfortunately, the EPA's overreaction to this situation has made settlement discussions impossible, and now, 7 years later and $5 million more, we are no closer to a resolution of the case than we were before.

In 1987, EPA undertook to determine the most cost-effective way to make the sites safe. The agency conducted public hearings that involved all of the defendants: McCarty's, Incorporated; the defunct corporation; five of the individual McCartys; Pacific Recycling; and Idaho Power Company. Despite considerable testimony that they were moving in the wrong direction, and over the objection of literally all of the defendants, EPA chose on-site fixation as their remediation strategy. What that literally meant was trying to roll everything up into a solid ball and to fix the contaminants on site.

Technical experts from Idaho Power Company and private companies who specialize in hazardous waste remediation testified that this procedure probably wouldn't work, and also that it was unnecessary to protect public safety. Unfortunately, after an entire year of experimenting with this proposed remedy, the agency determined that it would not be effective, so we are back to square one.

It is estimated that their experiments added between $1 million and $2 million to the cleanup costs. These are costs that will have to be borne by the defendants unless the agency sees fit to consider the costs a part of their overall operating and research budget.

It should be obvious that, as the cleanup costs rose, the possibility of any settlement diminished. Current estimates of the agency's costs for cleaning up this four and a half acre parcel of land are between $6 million and $7 million. Insurance companies who may have been willing to ante in resisted any attempt at a settlement. This is primarily because EPA continued to escalate their costs by unnecessary tests, by recalcitrance in the face of willing defendants, and by continuing their vague threats against the defendants that EPA's position cannot and should not be challenged.

The amount of tests conducted by EPA are staggering. This should again be noted because, according to the testimony of an EPA official in a public hearing in Pocatello, this site barely made it to the Superfund Priorities List. His comments were that the site would need to have been assigned a score of 28 or more on whatever scale that they use to get it onto the Superfund Priorities List. The score that they assigned to this site was a 29. Remember, many of the initial ground water samples were contaminated by sampler error, and hence were fallacious.

I realize that this is an extremely complicated case, and I have undoubtedly left out important facts and issues. Perhaps my summarization can hit the target.

First, in its initial response the agency erred in at least two critical ways. They failed to contact the legitimate decisionmakers, the landowners, to allow them critical involvement in early decisions, and the decision to place the site on the Priorities List was made erroneously. Subsequent agency actions were arbitrary and capricious and are serious breaches of fairness. Agency actions are appearing much like the horror stories many of us heard years ago about the Internal Revenue Service. Moreover, in several other instances EPA's actions have been arbitrary and capricious, to wit: the decision to experiment with the fixation approach to remediation. Their actions have transformed the defendants from cooperative opponents into combative adversaries. When it was possible to reach a settlement, the agency effectively closed the door on the defendants.

The issue before you today, that of the agency's alarming report on slag radiation, is another example in my mind of the kind of behavior that makes reasonable cooperation with the EPA difficult. If the agency refuses, because of its radical stance, to listen to reason, then how can we as citizens or business and industry be in any position to cooperate? The agency makes it financially and pragmatically impossible for most of us to be on their side even though, as Idahoans, we do share in the ultimate dream of protecting our pristine environment.

I am reminded of a story that I was told in graduate school about a theorist that told military practitioners that he had an idea on how to eliminate the problems created by German U-Boat warfare. In order to stop the sinking of Allied ships by submarines, the theorist told the brass that they simply could dry up the ocean.

When confronted with obvious ridicule, the theorist told the military men that he was a theorist, and that it was their job to find technical ways to implement the theory.

This absurd illustration is not unlike what we are facing here today. Theoretically, it would be wonderful to live in a world with no risk. Technically, we all know that this is impossible. We all know that, except the Environmental Protection Agency.

I respectfully suggest, Senator, that what we have here is a significant oversight problem. We need to rein in the bureaucracy and make it more accountable for its lack of effective working relationships with the public to resolve these problems.

Senator SYMMS. Thank you very much, David. That's a very powerful statement.

Bob Skinner—are you with Westinghouse?

STATEMENT OF BOB SKINNER, WESTINGHOUSE CORP.

Mr. SKINNER. Thank you, Senator. Yes, sir. I'm a health physicist by education, and a radiation worker. I have worked in areas where I have received radiation exposure as part of my job.

You have been listening today to some of the top people in the country in the health physics business. One of my current tasks is to educate the general public on radiation, and that's a very tough task. I think one of your underlying problems here is that you're talking to people about something that they don't really have a feel for. Everyone has a little computer inside of them that talks about risk. If you talk about driving a car, everybody understands that driving a car is somewhat risky, and the computer says, "I'll take that risk." If you talk about flying in an airplane—occasionally airplanes crash—people say, "I'll take that risk." If you talk to someone about radiation exposure, it's something they don't understand and the little computer inside them goes haywire.

So along with other responsibilities, we have a responsibility to talk to the people about what radiation exposure is and where it comes from. This type of thing is what the people need to know to make some good decisions.

When we talk about a case in the scientific community, we don't educate the people. We like to use big words, which makes it tough for them to understand. We use names for which they have no feel for the meaning.

Several years ago we detected things in parts per million. A few years ago we detected things in parts per billion. To give you an idea how small that is, if you are 34 years old, that's one second of your life. Well, today we're detecting things in parts per trillion and parts per quadrillion.

Now, the people that I have talked to have said that when we get to the point where we can detect all things in parts per quadrillion, we can take a common glass of water and we will be able to detect every element known to man in that glass of water. Does that render that glass of water undrinkable? The answer is no. We can now detect things in it that have been there all along, but are now just detectable.

You have heard the people talk about how radiation background varies greatly, depending on where you live and depending on your lifestyle. Well, risk analysis is an extremely tough business. Some of us in the scientific community sometimes laugh; we say that that's done by people with very thick glasses, lots of pencils in their pocket, and a portable calculator hanging on their belt. It's sometimes thought of as a wizardry. But those people who do that are very conscientious and very good at what they do.

Again, the risk that is being taken here has to be put in perspective. You've heard testimony from people that if we can't use the slag on the roads, then they will have to develop something else at a great cost. That means that they won't be able to sealcoat as many roads.

Now, I know the answer back east—and I've been back east—is that if you get ice on your roads, you drive along with a truck and dump all kinds of salt on it. Well, here in Idaho we don't use a lot of salt. The car that I had back east kind of fell apart and has essentially gone. I bought another car in Idaho and it doesn't fall apart because they don't use the salt. But if you had someone with a risk analysis, you could have them look and say, "Well, since we now have a larger cost for sealcoating the roads, and we cannot do as many, then what is the risk of someone sliding off the road in the wintertime because we don't throw tons of salt on our roads?" Again, it's all cost versus benefit. We're looking at everybody saying, "This is a big risk, this is a big risk." Again, we have to look at it and put it into perspective. Is it really a big risk, and what are the benefits?

I realize that I have no written testimony. I appreciate your letting me speak by signing up, and I thank you for your time.

Senator SYMMS. Thank you very much, Bob, for a very interesting statement.

I might just announce that the hearing record will be kept open for another two weeks, so if there are people who wish to testify—is there anybody out here that wants to testify? Please come on up and grab the microphone and state your name for the reporter. We will be happy to hear from you for a minute or two.

STATEMENT OF GLEN D. MARTIN

Mr. MARTIN. Thank you, Senator. I'm just a poor old farmboy from down here at Topaz, originally. I live in Pocatello now. I was born and raised in Topaz and got my schooling in a two-room grade school with four grades in one room and four grades in the other, and went through high school in Lava.

I had quite a bit of experience around this slag because originally, back in the 1950s, I got me a Geiger counter and wanted to go out and hunt a little of this uranium ore. In the times I traveled around, I had a business counter which, I think Bob Skinner can tell you, is quite a sensitive instrument. It would pick up radiation as high as three quarters of a mile away, driving in a car at about 30 miles an hour. I went all over this country and found one radiation spot within two miles of where I was born and raised. I'm still a little worried over it.

I did call Bob Skinner and talk to him some time ago about coming in and having some samples tested on this. He did it at the Mayor's office on my birthday when I had to be out working, but I'd like him to tell you what he got on the samples from the slag from Bannock.

Would you mind telling him about the readings, Bob?

Mr. SKINNER. Again, the counter I had was—if it was to be a car, you would consider it a Volkswagen. It is certainly not the best counter. But I took some samples of the material I had, and the reading on the slag was pretty much equivalent to the reading you get on a bottle of No-Salt because of the potassium it contains inside of it. The readings were comparable. Things like your Coleman lantern mantle, those things, were much higher reading than the slag.

Senator SYMMS. The Coleman lantern mantle?

Mr. SKINNER. Yes, sir. The Coleman lantern mantle, and many, many things—radium dial watches, etc.—were much, much higher. The slag was comparable in reading with a Geiger counter between a bottle of No-Salt which you can buy in any grocery store, and the sack of slag.

Senator SYMMS. Thank you.

Mr. MARTIN. While I'm talking I would like to say that when Monsanto built this last big furnace up here, I worked there for PD&M. Our parking lot was on that slag pile. I at that time was packing that Geiger counter, and I could get no reading from it.

When I took some samples over to the college, to the nuclear engineer, Dave Larentkis, he tested it. If we took it two feet off of it, we got no reading. That's why I didn't bet a reading when I had that Geiger counter up at Monsanto.

I'm sorry I didn't go to Monsanto and tell them what I knew at the time when they stopped them from selling slag.

I want to thank Bob Skinner for the help they've done to prove that this stuff is not hot.

I have here a letter from the INEL that tells how hot it was when I was out there working a few years ago. I'm glad I'm not one who believes in fear. I fought in World War II and listened to Axis Sally. We have heard Tokyo Rose, and we have also heard the EPA. I don't live in fear.

Senator SYMMS. Thank you very, very much for your statement. The record will be open for all of you to submit testimony.

I would like to personally thank all of the witnesses that contributed to this hearing. I would like to thank those officers and executives in the EPA and other agencies who came here to hear us out on this issue, and I do hope that as an end result we will be able to try to reach what most people—and I think all of us in this country—would like to have, which would be a common-sense accommodation to use the best scientific evidence we can have to continue on in our chase with technology to have an improving opportunity for the next generation of Americans to live in this country.

So the hearing is now adjourned, and thank you very much.

[Whereupon, at 1:29 p.m., the subcommittee was adjourned, to reconvene at the call of the Chair.]

[Statements submitted for the record follow:]

TESTIMONY OF
A. HENRY SCHILLING
DIRECTOR, OFFICE OF POLLUTION PREVENTION
U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
SUBCOMMITTEE ON NUCLEAR REGULATION
OF THE
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
SODA SPRINGS, IDAHO

August 21, 1990

Good morning, Mr. Chairman and Members of the Subcommittee. I am Hank Schilling, Director of the Office of Pollution Prevention at the U.S. Environmental Protection Agency in Washington, D.C. Thank you for the opportunity to share my views on how the use of phosphate slag and its risks should be understood and communicated.

BACKGROUND

Nearly everything government does involves some form of risk communication. Defense, education, social services, environmental protection ... all are areas where the government tries to stand between people and risks resulting from either natural or man-made phenomena. At EPA, our job is to protect people and the environment from various types of risks which would have an adverse effect on public health. We do not, however, as this hearing illustrates, do this in a vacuum.

Our jobs as public servants have changed over the last twenty years. No longer are we dealing primarily with insults to our environment that we can see or smell, ones we can easily trace and effectively control through technology. Our current day risks are often more subtle, exotic in their origins, and hard to quantify. And over the last twenty years, the public has become better informed and less tolerant of risks to life and health. Hence, our jobs as public servants no longer have to do solely with setting and administering environmental regulations. Explaining environmental risk and creating a process of decisionmaking that openly involves the public is part of our jobs.

RISK COMMUNICATION

Risk communication is the exchange of information between two or more parties concerning a hazard which can cause harm. In the abstract, risk communication can be categorized into four different types of activity, depending on the different objectives of the communication:

(1) Information and Education--informing and educating people about risks and risk assessment in general;

(2) Behavior Change and Protective Action--encouraging personal risk-reduction behavior;

(3) Disaster Warnings and Emergency Information--providing direction and guidance in disasters and emergencies; and

(4) Joint Problem Solving and Conflict Resolution--involving the public in a risk management decision or in resolving health, safety and environmental controversies.

In actual practice, these four types of risk communication overlap substantially. Rarely is there a situation that fits neatly into only one of these categories. The first category of informing and educating the public can be considered primarily a nondirecting activity. The next two categories, related to behavior change and disaster warnings, are primarily directive activities aimed at guiding people towards a specific action. The final category, joint problem solving, suggests a different approach--one that provides the public with information and enables people to work together to solve problems and reach decisions.

These categories are important because they lead risk communicators to deliver different types of messages. It is critical that risk communicators know and be clear about the nature of their problem and about the objectives of the communication in order to be successful. Not surprisingly, and as noted above, the risk communication process addressing the use and risks of phosphate slag in Soda Springs and Pocatello involves elements of all four categories. There are elements related to education and information exchange, as well as to possible behavior change. Joint problem solving is a key objective of the efforts undertaken by EPA's Regional Office and others in this situation.

Just as there are rarely single types of risk communication, there are also no easy prescriptions for successful risk communication. Those who have studied and participated in recent debates about risk communication, however, generally agree on seven "cardinal rules" which are detailed in a pamphlet drafted by Vincent T. Covello of Columbia University and Frederick Allen, a senior manager at EPA. Although many of the rules appear obvious, in practice they are not as simple as they seem. Part of the problem is that no two risk communication processes are the same, as consideration of the "cardinal rules" indicates. Audiences differ, information differs, timing differs--all this creating the need for specific case-by-case strategies. A closer examination of the "cardinal rules" points this out:

(1) **ACCEPT AND INVOLVE THE PUBLIC AS A LEGITIMATE PARTNER**

> A basic tenet of risk communication in a democracy is that people and communities have a right to participate in decisions that affect their lives, their property, and the things they value. In this context, communicators must be clear in their own minds that the risk communication process is one of negotiation rather than manipulation. Candor and honesty are essential ingredients. Communicators must view the process as one of communicating the nature of risk, rather than as one of manipulating the public into accepting a decision that has already been made.

In April, 1986, EPA initiated the Idaho Radionuclide Study, focusing on industrial sources of radiation exposure associated with the phosphorus industry in Soda Springs and Pocatello. Throughout the course of the study, meetings were held to inform concerned parties and keep them current on the progress of the study. Meetings in June, 1986 introduced the study and proposed schedule; meetings in July, 1987 included a presentation of the results of the aerial survey and a discussion of the upcoming field and residential monitoring. Progress report meetings were held with various officials in 1988 and in June, 1989 EPA presented findings of the study to the mayor and council members of Soda Springs and Pocatello, Bannock and Power County Commissioners, representatives from Senator McClure's Pocatello office, the media and industry representatives. The report was formally released to the public through meetings held in Pocatello and Soda Springs in May, 1990. Future discussions with State and local officials, the media, and the public will be aimed at determining what to do next, given the findings of the study.

(2) **PLAN CAREFULLY AND EVALUATE YOUR EFFORTS**

> Risk communication will be successful only if carefully planned. Since there is no single entity as "the public," communicators must consider the interests, needs, concerns, priorities, and preferences of different elements of "the public." Different risk communication goals, audiences and media require different risk communication strategies.

EPA's regional office in Seattle prepared a risk communication strategy related to this study in July, 1987, and has revised and updated it as appropriate over the course of the study.

(3) **LISTEN TO THE PUBLIC'S SPECIFIC CONCERNS**

> If you do not listen to people, you cannot expect them to listen to you. Communication is a two-way activity. This is obviously difficult. I would hazard a guess that, not unlike many conversations we have had with professional peers or family members, during which time we are attempting to express a viewpoint, there is always the perception between the two parties that each could have been a better listener.

(4) **BE HONEST, FRANK, AND OPEN**

> In communicating risk information, trust and credibility are your most precious assets. Technical information must be shared with, or at least made available to, the public. Too many decision makers are under the misconception that the public is not capable of understanding complex risk information. On the contrary, our history in environmental decisionmaking is full of successful examples of joint problem solving, involving complex issues, complex science, and complex solutions.

Regarding this particular situation, my understanding is that all information related to the Idaho Radionuclide Study is available to the public. EPA used questionnaires to prepare for public meetings in June of this year in order to identify specific issues on which the public needed more information. Fact sheets have been distributed to provide additional information and address key questions. Information repositories were established in July in libraries in Pocatello, Chubbuck and Soda Springs.

(5) **COORDINATE AND COLLABORATE WITH OTHER CREDIBLE SOURCES**

> Allies can be effective in helping you communicate risk information. It is worth the extra time to coordinate all inter- and intra-organizational communications.

As an aside at this point, all too often we wait to begin the risk communication process until after we can answer all questions. We have learned from painful experience that waiting to gather more data and to jump through all possible bureaucratic hoops can be fatal to the public confidence necessary for effective risk communication.

As I have noted, the risk communication process in this instance began early--when we did not have all the answers. Workplans were reviewed by EPA's Science Advisory Board's Radiation Advisory Committee; the final report was reviewed for its public health implications by the Agency for Toxic Substances and Disease Registry of the Public Health Service.

(6) **MEET THE NEEDS OF THE MEDIA**

> The media are a prime transmitter of information on risks; they play a critical role in setting agendas and in determining outcomes. Again, it's worth the time to provide risk information tailored to the needs of each type of media (i.e., graphics and other visual aids for television).

(7) **SPEAK CLEARLY AND WITH COMPASSION**

> Technical language and jargon are useful as professional shorthand, but they may be barriers to successful communication with the public. Risk communicators must strive to use "just-plain-English" when speaking about risk, or at the very least, define terms like "maximum exposed individual" when using them. They should use

> examples and anecdotes that make technical risk data come alive. Using easily understandable graphic and other visual materials is often very effective.
>
> Risk comparisons can be used to help put risks into perspective, but risk communicators should avoid comparisons that ignore distinctions that people consider important. A 1988 CMA publication, "Risk Communication, Risk Statistics and Risk Comparisons," outlined a number of risk comparison alternatives and concluded that comparing the same risk at different times, comparing the risk under discussion with a standard, and comparing different estimates of the same risk generally are the most effective categories to use when formulating risk comparisons.

Risk communication is often a very misunderstood process, one that can be unsatisfactory for everybody involved. Those communicators who send messages often feel that their messages have not been received, and those involved in the process who receive the messages often feel that their questions have not been answered. It is not a simple process. There are no fixed rules that are applied at the same time and in the same way in every circumstance.

This concludes my prepared testimony. Chuck Findley, Director of the Hazardous Waste Division in EPA's Region X, will focus on the specific details related to the Idaho Radionuclide Study, the science behind the study, the process leading to the release and communication of the study findings, and a discussion of next steps. I would be happy to address any questions you may have on risk communication.

TESTIMONY OF
CHARLES E. FINDLEY
DIRECTOR, HAZARDOUS WASTE DIVISION
REGION 10, U.S. ENVIRONMENTAL PROTECTION AGENCY
BEFORE THE
SUBCOMMITTEE ON NUCLEAR REGULATION
OF THE
COMMITTEE ON ENVIRONMENT AND PUBLIC WORKS
UNITED STATES SENATE
SODA SPRINGS, IDAHO

August 21, 1990

Introduction

Good morning, Mr. Chairman and Members of the Subcommittee. My name is Chuck Findley; I am the Director of the Hazardous Waste Division for Region 10 of the Environmental Protection Agency. Thank you for providing me with the opportunity to review several aspects of the Idaho Radionuclide Study.

First, I will describe the Idaho Radionuclide Study itself and the opportunities for community involvement throughout the study. Second, I will discuss the scientific review process which preceded the final release of the study. Third, I will address the study results as they pertain to EPA's mission to protect the environment and human health. And finally, I will discuss EPA's plans for the future, and indicate how we hope to involve the communities in the resolution of the problems associated with phosphorus slag.

The Idaho Radionuclide Study

Phosphate ores around Pocatello and Soda Springs contain naturally occurring uranium in elevated concentrations. These ores are mined and processed for elemental phosphorus by FMC in Pocatello and by Monsanto in Soda Springs. The radioactive slag resulting from this process has been used extensively in the area as an aggregate for concrete and asphalt in building foundations, sidewalks, and streets, thereby creating the potential for radiation exposure to the general public.

Concerns about radiation exposure from slag are not new. Published reports over the last half century have recognized the potential adverse health effects associated with exposure to low-levels of radiation. The uranium decay chain content of slag and the human exposure potential which it represents have been specifically recognized in the literature for the last two decades. Both the State of Idaho and EPA have been aware of the potential for health risks due to radiation from phosphate slag for some time. In 1977, because of concerns about radiation exposure in homes, the State of Idaho issued a memorandum recommending a voluntary ban on the use of slag in residential foundations.

In April 1986, as part of the rulemaking efforts under the Clean Air Act, the EPA initiated the Idaho Radionuclide Study. This study focused on industrial sources of radiation exposure associated with the phosphate industry in Pocatello and Soda Springs. Slag and stack emissions created during phosphate processing were the two sources of potential radiation exposure addressed by the study.

From the outset of the study, EPA held briefings for industry, local, county and State officials, Indian tribes, the Governor, members of the Congressional delegation, and the public. These meetings provided information about plans for the study, testing procedures, activities and conclusions.

The first public meetings were held on September 26, 1985 in Pocatello and Soda Springs to notify the residents of the upcoming study. In addition, various meetings were held at key junctures throughout the study. The community at large was kept abreast of progress on the investigation through public meetings, meetings with local officials and the press. Since many people did not anticipate the potential significance of the conclusions of the study, the meetings that we hosted over the last five years did not draw the attendance or generate the attention that we have recently seen.

EPA's Idaho Radionuclide Study is the most comprehensive study ever done on radiation exposure from the phosphorus industry in southeastern Idaho. The actual field investigation took place over a two year period. Measurements of radiation associated with streets and sidewalks were made using a helicopter mounted with sophisticated radiation detection equipment. This sampling enabled quantification of radiation fields around the slag and mapping of the extent of slag distribution throughout the communities. Ground surveys of 119 residential properties in Pocatello and Soda Springs were also conducted with the permission of property owners.

Based on the evidence from the field survey, and using reasonable estimates of the amount of time people spend in their homes and on the streets, it is clear that citizens in Pocatello and Soda Springs are being exposed to radiation from phosphorus slag. These exposure levels are high in comparison to other man-made sources of radiation, and the risks are high in comparison to risks presented by many chemical hazards. EPA firmly believes that the scientific evidence supporting elevated risks to individuals in southeastern Idaho due to slag is clear and convincing.

Scientific Review of the Study

The Idaho Radionuclide Study was the subject of extensive scientific review and scrutiny at critical stages of its development. In September of 1986, EPA requested its Science Advisory Board (SAB) to review the draft work plan for the Idaho Radionuclide Study. The draft design was reviewed by the Radiation Advisory Committee of the SAB. The Committee made a number of recommendations which were incorporated into the final design plan. The stated objective of the study was "to determine the magnitude and relative importance of various industrial sources of radiation and to estimate the dose to the populations of Pocatello and Soda Springs. On October 9, 1987, the SAB concluded, in a letter to EPA, that the sampling approach and study design of the revised plan were of sufficient quality and detail to meet the objectives of the investigation. In addition, the dose and risk factors that were used in the analysis during the study had recently been reviewed by the SAB as part of the Agency's rulemaking for radionuclides under the Clean Air Act.

EPA has sent copies of the final Idaho Radionuclide Study to members of the SAB Radiation Advisory Committee. We will be providing them with a briefing on the study at their next meeting, currently scheduled for October 23, 1990. The SAB will hear how EPA carried out the sampling protocol, the nature of the data obtained and how EPA applied this data to develop estimates of risk to the communities.

EPA sought additional independent review prior to releasing the final results to the public. The final study report was reviewed by the Agency for Toxic Substances and Disease Registry (ATSDR) of the Public Health Service. ATSDR is mandated by Congress to advise the EPA in matters of public health. ATSDR was asked to comment on the appropriateness of the methods used in the study and the extent to which the study indicated the potential for significant health risks to the public. EPA has sought ATSDR review of studies of this kind in the past.

The ATSDR provided EPA with a written Health Consultation on May 18, 1990. The consultation stated that ATSDR found the exposure pathways and scenarios used by EPA in the Idaho Radionuclide Study to be credible. However, the consultation suggested that EPA could have been justified in using higher cancer potency factors recommended by the National Academy of Sciences in their recent report on the Biological Effects of Ionizing Radiation (BEIR5). The BEIR5 report was released after the final draft of the Idaho Radionculide Study was prepared. The larger values, if used, would have approximately doubled the risks predicted by the EPA.

The ATSDR consultation concluded that the exposure levels in Soda Springs and Pocatello may pose a distinct public health hazard to the residents. The consultation went on to recommend that actions be taken to alleviate the potential health effects resulting from exposure to gamma radiation due to slag in the area.

Based on the independent review of the study design by the SAB, the internal EPA reviews, and the independent review of the final report by ATSDR, EPA is of the opinion that the Idaho Radionuclide Study is of sufficient quality to provide a basis for further investigation of the need for remedial action.

The Results of the Idaho Radionuclide Study

During the Idaho Radionuclide Study, gamma radiation from slag was found to be the primary health concern to residents of Soda Springs and Pocatello. Gamma rays (like X-Rays) are capable of penetrating body tissues. With sufficient exposure, gamma rays are known to cause a variety of cancers in humans.

The study revealed elevated levels of gamma radiation exposure in Pocatello and Soda Springs. In Pocatello, the principal path of radiation exposure was found to be through slag-containing sidewalks and streets. In Soda Springs, radiation from slag-containing foundations in some residential homes represents a significant path of exposure, in addition to the streets and sidewalks.

Health risks were evaluated separately for "average" and "maximally exposed" individuals. Differences in the estimated risks to the two groups result from differences in the amount of radiation dose received. For the "maximally exposed individuals" (MEI), risk estimates were based on a theoretical "worst case" combination of exposures in the home, workplace, and during outdoor activity. Such an individual might be someone who lives in a home with a slag-containing foundation, who spends a good deal of time in the basement, and who works all day on slag paved asphalt streets. Average exposures were calculated using exposure scenarios which were considered to be characteristic of a much wider segment of the population, most of whom would have intermittent exposure to slag.

The National Academy of Sciences has developed "cancer potency factors" that it recommends be used to estimate the risk of cancer associated with low levels of radiation (such as the levels of radiation found in Pocatello and Soda Springs). In estimating the cancer risks from phosphorus slag, EPA used the cancer potency factors recommended by Academy.

The overall conclusion of the Idaho Radionuclide Study is that lifetime exposure (70 years) to slag-associated radiation levels found in Soda Springs and Pocatello will result in a significant increase in the probability or chance of getting cancer for some individuals. Based on EPA's calculations, the average lifetime exposures would result in an increased cancer risk of 4 in 10,000 in Pocatello and 14 in 10,000 in Soda Springs (interpreted as 14 additional cancer deaths in a population of 10,000, or an increase of 14 chances in 10,000 that an individual will get cancer). In the case of maximally exposed individuals, the risk is estimated to be 1 in 250 in Pocatello and 1 in 167 in Soda Springs. The number of maximally exposed individuals is not known. However, we assume that it would be a small percentage of the total population due to the combination of factors which would contribute to high slag exposure.

The Significance of the Southeast Idaho Radiation Risks Relative to National and International Guidance

In determining whether action should be taken to limit radiation exposure, the EPA considers guidance from the International Commission on Radiation Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP). The basic guidance from the ICRP and the NCRP for limiting exposure to members of the general public is that an individual annual dose should not exceed 100 millirem per year from the sum of all man-made radiation sources, excluding medical sources. Based on the EPA estimates, the Agency thinks that some members of the general public living in southeast Idaho may be receiving over twice that amount from slag alone, primarily due to the presence of the material in their homes.

According to the EPA study, radiation dose from exposure to slag to the average resident of Soda Springs is approximately 52 millirem per year. The dose to the maximally exposed individual is estimated to be about 205 millirem per year. By comparison, EPA recently established regulations under the Clean Air Act to limit public exposure to airborne radionuclides to 10 millirem per year. In other words, the average Soda Springs resident is receiving over 5 times the radiation dose permitted from a nuclear reactor; the maximally exposed individual over 20 times the permitted dose.

Similarly, in terms of potential population risks, the combined radiation exposure to the residents in Soda Springs and Pocatello due to slag is large by comparison to other industrial sources of radiation exposure. Currently, the total radiation dose to the population around the Idaho Nuclear Engineering Laboratory is estimated to be about two person-rem per year. The construction use of slag, by comparison, causes a reported annual population dose of about 1,000 person-rem per year. The people living in the area are involuntarily being exposed to an unnecessarily high level of radiation and high cancer risk. Typically, we recommend that such a situation be avoided.

Where Do We Go From Here?

EPA is seeking the help of State and local authorities and the community, in developing a comprehensive, long-range strategy for minimizing both the current and future risks associated with slag exposure. As a part of the process, we believe that there are three issues which need to be addressed: (1) ensuring that the problems associated with radioactive slag do not get worse; (2) deciding what needs to be done to protect those individuals who are currently at highest risk; and (3) deciding what should be done about areas now paved with slag.

The first important step is to keep the problem from spreading by restricting any additional distribution of slag in the communities. We applaud the decisions that have been made recently by the companies and State and local governments. We understand that, as of July 1, 1990, Monsanto and FMC voluntarily discontinued the use of slag, several southeast Idaho towns (including Soda Springs, Pocatello and Chubbuck) suspended the use of slag for street repair, and the Idaho State Transportation Department decided not to use slag on future projects.

In the Report to Congress on Special Wastes From Mineral Processing, issued by EPA on July 31, 1990, the Agency announced plans to use the authority of the Resource Conservation and Recovery Act to ban the use of phosphate slag in construction and/or land reclamation. EPA is currently soliciting comments on the appropriate regulatory language that should be used and how such a ban should be implemented. Persons interested in commenting on the planned ban should consult the August 7, 1990 Federal Register, page 32135, for further information.

The next step must be to reduce the exposure to those individuals who are currently at the greatest risk, namely, the people living in homes with slag foundations. We know that there are such homes in Soda Springs, and so EPA will be focusing in the near term on voluntary home testing in that community. Based on the results of this testing, and in consultation with the property owners, decisions will be made on the need for remedial action.

Before we initiate either the additional home testing or undertake any remedial actions, however, EPA will share our plans with the public and ask for their input. We are in the process of developing a proposed sampling plan for the voluntary radiation testing of homes in Soda Springs. We are also identifying options for establishing remedial "action levels". The action level finally selected will be a radiation level for residential homes above which EPA will recommend that corrective action be taken. A formal public comment period will precede EPA's decisions on a final home testing plan and action level.

Finally, EPA plans to involve the communities in determining a long term course of action for dealing with the increased radiation risks associated with the presence of slag in streets and sidewalks. Currently, specific recommendations concerning the need for road or sidewalk remediation have not been made. We intend to work with the affected communities and State and local officials in making these determinations, after we have initiated efforts to address the more serious risks associated with slag in homes. I would just observe that if remedial action is found to be necessary for some limited number of streets and sidewalks, we anticipate that it can be achieved over a reasonable period of 15 to 20 years as a part of State and local road maintenance programs.

Throughout the process of addressing the phosphorous slag problem, community involvement will be critical, and we are working hard to ensure that it occurs in a positive and productive way. Since the release of the final Idaho Radionuclide Study in May, public meetings, questionnaires and informal meetings have helped EPA to better understand the concerns of the community. We are now developing a Community Relations Plan based on the input we received. While our immediate focus is on Soda Springs, it is important that other communities be kept well informed and that they be involved in the decision making process as it effects them. EPA has information repositories in three communities; our ever-expanding mailing list includes individuals from throughout the area.

I want to assure you that EPA will be open and responsive to the people of southeastern Idaho. We will continue to share our information with them, and to listen to their concerns. As we conduct additional sampling and move forward with decisions, we will do everything possible to ensure that our science is sound, the material we present is accurate and complete, and the public is given an opportunity to participate in the decision making process in a meaningful way.

Conclusion

Mr. Chairman, since EPA released its Idaho Radionuclide Study in May, we have heard concerns expressed by the community, by elected officials, and by the affected companies. We agree with many of the concerns that have been voiced, including the following:

(1) **The importance of good science.** People want to be sure that EPA's estimate of the radiation risk they face is based on good scientific analysis. We most certainly agree. As I have discussed above, EPA's Idaho Radionuclide Study has been conducted using approved scientific methods and is based on nationally accepted scientific techniques for estimating health risks at low levels of radiation exposure. Both the design of the study and the study itself have undergone appropriate scientific review.

(2) **Public review of testing plans.** People want to be sure that they will have the opportunity to review EPA plans for further testing of homes, and they want to review EPA proposals for action levels that would trigger remediation. We agree. We will give the communities the chance to review these plans before we do any further testing or make final recommendations.

(3) **Effective communication and effective public involvement.** People want EPA to communicate with them effectively and to give them a chance to impact the decisions that will affect them. We agree. We are committed to working out our strategies for dealing with the risks from radioactive slag together with the local communities.

(4) **Social and economic impacts.** People are concerned about the social and economic impact of this problem on the affected communities. We understand that concern. However, we cannot

completely ignore the radiation risks because of social or economic concerns, as some might have us do. But we do believe that it is critical for EPA to find ways to reduce the radiation risks that fit the needs of the communities.

In conclusion, I ask that we all work together to develop a plan which will protect the health and the prosperity of these communities.

Thank you for this opportunity to testify. I would be happy to respond to any questions you may have at this time.

International Overview of Low Level Radiation Exposure to the Public

John R. Horan C.H.P.
Radiation Protection Consultant
1791 Coronado St.
Idaho Falls, Idaho 83404

Oral testimony presented on August 21, 1990 at the Public Hearing on Phosphate Slag Communication in Soda Springs, Idaho before the Subcommittee on Nuclear Regulation of the Senate Environment and Public Works Committee.

Over the past 40 years no other scientific issue has aroused so much public controversy as the biological effects of ionizing radiation. This debate will not be resolved today in Soda Springs, Idaho. In fact, the estimation of cancer risk at low levels of radiation dose may always remain a controversial issue. It is so complex it may never be deciphered. Many leading scientists believe it may be far beyond our knowledge in medicine, biology, chemistry, physics and computer sciences.

If the zero threshold linear dose response model is valid at low doses, then, to observe any increase in cancer directly from exposures of 100 mrem/yr. would require an estimated 6 billion people. That's more than the current population of the world. By the year 2050 we can hope to have better data on exposed human populations as the result of the studies now under way in the USSR following the Chernobyl accident. In the meantime, we must recognize that radiation caused cancers are so rarely seen, after exposure to low doses of radiation, simply because the exposures are so small.

Two major factors which complicate this search for realistic solutions are:

1st. Natural background radiation is found in every aspect of God's Creation, from cells to stars.

2nd. Natural radiation is theoretically responsible for less than 1 out of every 200 cancers.

The difficult task of estimating the cancer risk from low level radiation is the responsibility of three prestigious organizations.

- United Nations Scientific Committee on Effects of Atomic Radiation (UNSCEAR) - 1955
- International Commission on Radiological Protection (ICRP) - 1928
- National Committee on Radiation Protection and Measurements (NCRP) since 1921 (Congressional Charter - 1964)

These groups are composed of highly respected scientists from around the world. They study all available experimental data, technical reports and statistical studies. Their conclusions and recommendations are widely accepted by organizations charged with regulating radiation throughout the world.

Briefly the essence of their most recent reports, as they apply to this Hearing, are the following consensus findings and recommendations:

1st. The human race has been exposed to natural radiation levels of more than 300 mrem/yr (including radon) since the beginning of time.

2nd. High levels of radiation exposure produce measurable biological effects. These are observed at acute doses greater than 10,000 mrem.

3rd. The major health effect associated with radiation exposure is an increased risk of developing cancer, primarily leukemia.

4th. Exposure to low level radiation is an insignificant hazard to human health. Low level is defined as background exposure levels below 500 mrem/yr.

5th. For low level exposure, the lower limit in radiation risk estimates may extend to zero.

6th. To be conservative, it is assumed that any dose from ionizing radiation, no matter how small, has some health risk. A single radioactive particle can cause a cancer by injuring a single cell.

However, the probability is so small we cannot even visualize it; one chance in about 50 quadrillion, that's 5 with 16 zeros after it.

7th. Unnecessary radiation exposure should be kept as low as reasonably achievable, taking into account economic and social aspects.

8th. Radiation Protection of the general public should be limited to levels comparable with those commonly experienced and accepted in other circumstances to which the public is normally exposed. (NCRP-#91).

In conclusion, man has been involuntarily exposed to low levels of radiation exposure from his environment since the beginning of time. This has caused a hypothetical very low degree of risk to cancer which cannot be quantified. Today, with greater knowledge of other hazards throughout our environment, radiation protection should be limited to reasonable regulatory activities which have as their goal a balance between the needs of society, the benefits gained and economic factors.

Mr. Chairman, my written testimony which I will submit later this week will be a critique of EPA's Idaho Radionuclide Study of April 1990 based on these findings and recommendations.

CRITICAL REVIEW OF THE IDAHO RADIONUCLIDE STUDY

(EPA/520/6-90/008 - 4/90)

By

John R. Horan, C.H.P.

Radiation Protection Consultant

1791 Coronado St.
Idaho Falls, Idaho 83404

August 31, 1990

Supporting statement submitted for the record for the Public Hearing on Phosphate Slag Communication on August 21, 1990 in Soda Springs, Idaho for the Subcommittee on Nuclear Regulation of the Senate Environmental and Public Works Committee.

I. Introduction

The Idaho Radionuclide Study produced by the Environmental Protection Agency's (EPA), Las Vegas Facility, is a pseudo-scientific document which can only miss-inform and alarm segments of the public, adding to the effect of radiation phobia. The study lacks technical depth by producing highly artificial numbers; ignores limitations and contrary indications in the scientific literature as well as uncertainties in theory and calculations recognized by international authorities. As a public information document, it is overly complex and fails to place its conclusions in perspective with other health risks. Overall it would not be worthy as an M.S. thesis at a reputable university. Therefore it is recommended that the study be withdrawn and submitted to an outside peer review group for evaluation and revision.

II. Summary

There is no question that phosphorus slag used in building materials in some Soda Springs homes has resulted in some increased exposure to the occupants. It has not been demonstrated conclusively that this increase in background radiation exposure is substantially above average levels, nor that a health hazard exists.

But of more importance is the misinformation contained in the EPA statement that the lifetime risk of contracting a fatal cancer from phosphate slag gamma radiation for Soda Springs, Idaho residents is 0.0014. Scientists throughout the world recognize that the risk from low level exposure may actually be zero. Therefore, one must project any risk estimates as a range of values starting with zero risk. This EPA has conveniently overlooked in their report. They have also failed to note that risk estimates are subject to inherent uncertainties up to a factor of 5.

Because of inherent difficulty in measuring environmental radiation levels near background and projecting doses to humans, the average dose postulated by EPA for Soda Springs residents, namely 52 ± 7 mrem/y, could be in error by at least a factor of 2.

In radiation protection one needs to know the total risk picture from all health, safety and environmental threats which shorten our life span. It is a waste of resources to apply the ambitious level of radiation protection adopted by the world to the correction of minor radiological risks while ignoring other areas of high risk prevention. EPA, by failing to make risk comparisons, prevents the public from realizing that the projected exposure of each resident in Pocatello, Idaho to 12 mrem/y is equivalent to the risk from crossing a busy street once a week. In a similar way the risk to the residents of Soda Springs, Idaho from an average calculated exposure of 52 mrem/y is equivalent to a reduced life expectancy resulting from riding 170 miles in a car.

III. Detailed Evaluation

A. Biological Factors

Low-dose radiation effects are not discernible by direct observation. Radiation effects in humans are estimated by extrapolation from either historically observed effects of high-dose exposures - (Hiroshima - Nagasaki survivors) or experimentally observed effects of animal exposures. While there are major uncertainties in extrapolation of experimentally observed effects of animal exposures to humans, it is known that low-dose rates reduce the cancer risk. Animal experiments suggest the reduction could be as great as a factor of 10. These extrapolation processes have been the subject of serious questions for decades. These questions have not been fully resolved.

Radiation-associated cancers are so rarely seen after low-dose radiation because the exposures are so small. Also, the number of cancers caused by over 2000 carcinogens in man's environment is so large that these rare cancers are lost in the "background noise" of the statistics. Natural radiation is responsible for less than 1 out of every 200 cancers (American Council on Science and Health (1/99)).

Table I presents the average radiation dose to each American by source based on The National Council on Radiation Protection and Measurements (NCRP) Report #94, issued 11/87. The average American lives between sea level and 500 feet elevation with a resulting annual exposure of 360 mrem from all sources, or a total of 25,200 mrem over an average 70 year life span. Inhabitants of Soda Springs, Idaho at an elevation of 5779 feet on the average, would receive an additional exposure of 24 mrem per year.

The whole process of estimation of risk from radiation exposure may remain a controversial issue over the next 20 to 40 years. Extrapolation of observed data requires fundamental understanding that is just not available to today's scientists. The understanding of the mechanics of cancer induction by radiation particularly in humans is extremely limited. It is so complex it may never be resolved.

The BEIR Committee Report, Health Effects of Exposure to Low Levels of Ionizing Radiation, National Research Council (1/90), does conclude that the existence of a threshold dose (below which there is "de minimus" or zero risk) cannot be ruled out in the low-dose range.

In addition there are indications in the scientific literature that certain low-dose radiation effects may be of a beneficial nature, (Hormesis), this evidence is not conclusive. Further studies are needed on the following reported occurrences.

- Non specific extension of life span
- Stimulation of the immune response system
- Increased resistance to harmful effects of subsequent radiation exposure.

TABLE 1

Average Annual Radiation Dose to each American by Source

(Underlined sources are man made)

Source	mrem/yr
Radon in homes	198.0
Medical X-rays	39.0
Natural internal contamination	39.0
Soil and rocks	28.0
Outer Space	28.0
Nuclear medicine	14.0
Consumer products	11.0
Occupational	1.1
Fallout from nuclear weapons	1.0
Nuclear power cycle	0.3
Miscellaneous	0.3
	360 mrem/yr

NCRP-11/87
#94

Finally present risk calculations do not take credit for biological repair mechanisms known to exist; e.g., repair of molecular lesions.

B. Major Flaws

The two major flaws with the Idaho Radionuclide Study are:

#1. There is no acknowledgement that the risk to the inhabitants of Soda Springs, Idaho may actually be zero. To be honest, this report should show a range of values for the risk to individuals from 0 to an absolute maximum of perhaps 200 mrem. BEIR V recognizes that current knowledge cannot rule out the possibility that there are no risks from exposures to levels of radiation comparable to natural background. To quote directly, "We acknowledge that the lower limit of the range of uncertainty in the risk estimates extends to zero." Also, risk estimates at low doses are highly questionable. Worldwide studies of populations chronically exposed to low-level radiation, such as residing in regions of elevated background radiation up to an average of 1300 mr/y (Kerala, India) have not shown either consistent or conclusive evidence of an associated increase in the risk of cancer.

#2 The uncertainties accepted by the scientific community for extrapolation of data and the assumptions of simplified models are ignored. Only a brief mention is made on two pages that propagated sampling error estimates yielded an equivalent standard deviation of 52 ± 7 mrem/y and 197 ± 25 person-rem/y for Soda Springs, Idaho. These raw error estimates are not carried forward into the findings. After 40 years of study, the BEIR V Executive Summary reported ". . . risk estimates derived from epidemiological and animal data should not be considered precise . . ." ". . . estimates of the ultimate magnitude of the risk for the total population is uncertain and calls for further study."

A large number of variable factors collectively modify the risk of inducing cancer as a result of low-dose radiation exposure. To briefly summarize these variables, Table 2 uses a grouping by biological, physical and statistical factors based on an article published by Dr. Jacob I. Fabrikant (Chairman, BEIR IV Committee), in the July 1990 issue of the Health Physics Journal. It is because of these many uncertainties that Dr. Fabrikant, a prominent member of the NCRP and ICRP (International Commission on Radiological Protection) concludes that ". . . the process of estimating of cancer risk at low-dose levels may remain a controversial issue that may never be resolved - it may be beyond the abilities of scientists and mathematics to decipher."

While the BEIR V report uses the most recent corrections to the source terms for the Hiroshima and Nagasaki survivors, there are still unreconciled differences in the radiation effects between the victims in the two cities. Scientists are also faced with the serious fundamental problem of the population factor. The Japanese data is from a 1945 homogeneous Asian population with wartime diets after 5 years of stress, as well as a population where almost all the males, age 18 to 40, were serving overseas. How can one transpose the

TABLE 2

FACTORS MODIFYING RISK OF RADIATION INDUCED CANCERS AT LOW DOSES

Biological Factors	Physical Factors	Statistical Factors
Age	Precision of Measurements	Dose Response Relationship
Sex	Radiation Dose	Risk Coefficients
Diet	Dose Rate	Time Response Projection Models
Smoking Habits	Time Fractionation of Dose	Animal Experiments Applied to Humans
Hereditary Aspects	Radiation Quality	Extrapolation of High Dose Data
General Health	Source Geometry	Rarity of Radiation Induced Cancers
Mental Attitude	Shielding Effects	Limited Epidemologic Data
Hormonal Condition	Uniformity of Body Exposure	Limited Cancer Registry Data
Immune Status		Dynamics of Change over a Lifetime
Other Diseases		Sample Size
Other Carcinogens		Sampling Frequency
Ethnic Variations		Sampling Variations
General Lifestyle		Magnitude of Bias
Type of Cells		Non-systematic Errors
Tissue Sites		
Latency Period		
Time to Tumor Recognition		
Baseline Cancer Incidence Data		
Heterogenity in Response		
Mechanism of Cancer Induction		
Response Relationship to Different Cancers		
DNA Repair		

observed effects to a heterogeneous American population in the 1980 - 2030 period? The whole extrapolation process is subject to serious question. The BEIR V Committee has warned us that this most important uncertainty is not factored into current dose estimate models. Perhaps we will have to wait until BEIR X is issued about the year 2010 to obtain better answers. But for the present time we should be guided by NCRP #91, Recommendations on Limits for Exposure to Ionizing Radiation (6/1/87). ". . . risk estimates are subject to uncertainties of perhaps up to a factor of about 5."

Two highly qualified contractors were utilized by EPA to perform the aerial and ground surveys namely:

- The Remote Sensing Laboratory of EG&G, Inc. Las Vegas, Nevada.
- Battelle's Pacific Northwest Laboratory

The equipment used was advanced state of the art. Collecting reliable information with high accuracy is very important in surveys because no single factor modifies the calculation of cancer risk estimates more than the quantity of radiation dose absorbed in the cells and tissues of the body.

In 1985, the National Institute of Health (NIH-85-2748) reported that for low-LET radiation organ dose can be estimated within a factor of perhaps 2 for film badged or monitored personnel. However, the absorbed radiation dose estimates are more uncertain when based on environmental readings that may not be in the immediate vicinity and which are subject to environmental and body shielding and thus vary over time. This is the case for the Idaho Radionuclide Study.

IV. Risk Comparison

An international concensus on Radiation: Doses, Effects and Risks was published by the United Nations Environment Program (UNEP) in December, 1985. Among the conclusions were the following:

- Low-level radiation poses a relatively minor public hazard.

- There seems to be little public concern about natural radiation which contributes 80% of the average dose worldwide.

- The risks that the public perceives to be the highest are not always those that actually kill the most people.

- Well known risks, such as from motorcycle riding, skiing, climbing, smoking - and even muggers and heroin - inspire little fear.

- The public needs to be involved far more in assessing the risks it is being asked to undertake - and in passing judgement on them.

Based on the available data on the number of deaths per year in the United States, the primary causes are:

TABLE 3 PRIMARY CAUSES OF DEATHS IN THE USA (1980)

	Risk	Deaths/yr
1.	Smoking	150,000
2.	Alcoholic Beverages	100,000
3.	Motor Vehicles	50,000
4.	Hand Guns	17,000
5.	Electric Power	14,000
6.	Ionizing Radiation	3,300
7.	Motorcycles	3,000
8.	Swimming	3,000
9.	Surgery	2,800
10.	Railways	2,000

The Ionizing Radiation figure of 3,300 deaths was calculated by the author based on the following:

- US exposure from all sources - 8,350,000 person-rem (NCRP #93-9/87)
- 400 cancer deaths per 1,000,000 person-rem (EPA - Idaho Radionuclide Study - 4/90)

If all the people in the U.S. were exposed to the additional risk of 50 mrem/y the estimated Soda Springs, Idaho average dose from phosphorus slag in building material; the number of ionizing radiation fatalities per year would increase theoretically by 14% or 520 to 3820; insufficient to change its ranking from 6th to 5th place.

Many statistical tests are performed where one can expect roughly 5% of the results to be "significant" by chance when there is no true effect. Hence, it is highly likely that risk estimates derived by selecting the significant difference in low-dose studies of small to moderate size populations will be substantially biased in the upward direction. There is no evidence that this type of statistical bias has been eliminated from this report. In low-dose studies the biases may equal or exceed the magnitude of the expected effects.

The EPA report projects risk levels to the year 2030 A.D. This is an extremely awkward and unscientific approach in such an uncertain world. The 70 year projection used for dose estimates ignores the major biological and genetic break-throughs we have been experiencing in recent years and the promise they hold for the future. This includes cures for many types of cancers. In fact baseline mortality figures are already changing, making it very difficult for lifetime projections. As an example, lifespan in the USA has changed from about 35 years in the 18th century to over 75 years today. We see more cancers today because it is mainly a disease of old age. In less than 20 years the mortality for stomach cancer has dropped by 50%, while deaths to women from lung cancer has increased 250%. We can anticipate many technological advances, improved medical diagnosis and earlier treatment along with an even higher standard of living, to drastically change cancer mortality in the next 20 years as a direct result of the dynamic process of change. Therefore, a linear projection from 1990 to 2030 cannot be made with any reasonable degree of accuracy as was done in this study. Such projections only produce "fuzzy" numbers which are of little value in determining the actual risk involved.

V. Basic Scientific Flaws

The lack of technical depth and incompleteness of the analysis is revealed through the following indicators of poor scientific quality in the EPA report. It is because of these technical inadequacies as well as the failures in risk communications, misuse of the methodology and findings that EPA should withdraw the report for peer review.

Something as basic as the title of the report, Idaho Radionuclude Study is inaccurate since it does not portray the actual contents, namely a preliminary evaluation of phosphate slag exposure in two communities in Idaho. Major radionuclides such as radon (throughout the State) and thorium (Lowman area) are not included along with thermal spring radioactivity throughout the southern part of the State.

17 out of 22 tables do not indicate that the data represents calculated or estimated values.

It's an abuse of scientific notation to use 3, 4, and 5 significant figures throughout the report. 197.4 person-rem should be reported as 200 person-rem since only one significant figure can be justified. Otherwise a degree of accuracy in the data is being projected which cannot be supported factually.

Very limited use is made of the standard deviation for measured or calculated numbers. As one example 197.4 person-rem reportedly had an equivalent standard deviation of ± 25 but this is not used in the summary; most likely because this claimed precision is not the complete picture.

The calculations of a maximally exposed individual is a meaningless exercise in "fuzzy" numbers. A hypothetical combination of maximum possible exposures has been assumed and found to apply to a college student living in a basement. We are led to believe he will continue this life style for another 50 years.

A total assessment of the various sources of exposure, which was the original 1985 intent, has not been done; neither radon in air nor the water pathway for radionuclides has been analyzed.

Background aerial surveys for Soda Springs were made near Fort Hall, Idaho over 60 miles away and at 1300 feet lower elevation.

Aerial surveys were performed in June and July, 1986 while ground surveys were made in Summer and Fall of 1987. It's presumed that environmental conditions were the same in these two different years.

Ground surveys of only 19 homes out of about 1100 in Soda Springs does not provide an adequate sample for good statistics.

None of the 100 homes surveyed in Pocatello had phosphate slag foundations. Now additional homes must be surveyed in 1991.

The 5 point Quality Assurance program was very limited in coverage and would not meet state of the art criteria.

Pocatello airport meterology was used for the Soda Springs study. The differences involved are 50 miles separation, a mountain range barrier, and an altitude difference of 1300 feet.

The reference list does not include the U.S. "bible" on population exposures, e.g., NCRP Report #93, Ionizing Radiation Exposure of the Population of the United States (9/1/87).

The United Nation's Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), ICRP, and NCRP all agree that indoor radon, not gamma radiation from phosphate slag, is potentially the most important radiation exposure problem that currently exists in the world. EPA scientists recognize radon gas as the most significant environmental health risk in the USA. This raises the question of why the Idaho Radionuclide Study does not even mention this primary health risk which is responsible for an average radiation dose of 198 mrem/y. This dose is 4 times the estimated exposures to Soda Springs residents from slag gamma radiation and 14 times the estimated exposure to Pocatello residents. To say the least this indicates a false sense of priority for the limited resources available to protect man from radiological hazards.

VI. Dose Reduction Considerations

Federal agencies are under increasingly intense pressure, many of a political nature, to reduce environmental exposures from biological, chemical, and radioactive sources that may present little health threat to human populations. As a result regulatory decisions are being made (or have been made) to undertake the mitigation of some extremely low levels of chemicals or radioactivity in the environment.

However, since the NCRP has defined 1 mrem/y as a negligible risk level to exposed individuals, some thought must be given to possible corrective actions in the event exposures greater than 1 mrem/y are produced.

On September 1, 1987, in NCRP Report #93, Ionizing Radiation Exposure of the Population of the U.S., the recommendation was made by the National Committee on Radiation Protection and Measurement that dose reduction " . . . would seem not to be feasible or cost effective in the case of building materials or mining and agricultural products." In reaching this conclusion, the NCRP took into account the ALARA system of dose limitation based on keeping exposures "as low as reasonably achievable" economic and social factors being taken into account.

A prior report of the NCRP #91, Recommendations on Limits for Exposure to Ionizing Radiation (6/1/87) recommended the following limitations of exposure to members of the public from man-made sources other than medical and natural background exposures.

External Exposure Conditions	Mrem/year
1. Special Circumstances (including emergencies)	10,000
2. Skin, lens of eye, extremeties Continuously Exposed	5.000
3. Vital organs and tissues Infrequently exposed populations	500
4. Vital organs and tissues Continuously exposed populations	100

Finally, NCRP #91 has made the following recommendations concerning remedial action levels for members of the public from enhanced natural radiation sources when they continually exceed the following:

- 500 mrem/y for all external sources other than medical exposures but including natural background
- 2000 mrem/y (2WLM/y) for radon and its decay products.

The message we continually receive from the ICRP and NCRP is that the limited resources available for mitigation should be focused on the more important radiological risks, namely:

- Radon in homes and schools
- Reduce tobacco product use (natural radionuclides)
- Reduce unjustified medical exposures
- Reduce radionuclides in domestic water supplies

Each of the above risks are responsible for more than 1,000,000 person-rem per year. The whole purpose of ALARA (cost benefit analysis) is a tool to help us use available money and people to save the maximum number of lives.

VII. Conclusion

Mankind has been involuntarily exposed to natural ionizing radiation levels of more than 300 mrem/y since the beginning of time. While we conservatively assume that any dose from radiation has some health risk, primarily the increased possibility of developing cancer, this very low level of risk to cancer cannot be quantified. Worldwide studies of populations chronically exposed to elevated background radiation have not shown conclusive evidence of an associated increase in the risk of cancer. In fact the very growth in the population of the world to over 6,000,000,000 people argues favorably that radiological risks are indeed quite low.

The lower limit of radiation risk estimates may extend to zero risk while measurable biological effects are observed following acute doses greater than 10,000 mrem. However, good radiation protection practice calls for reducing unnecessary radiation exposure to levels as low as reasonably achievable provided that economic and social aspects receive appropriate consideration. This means than radiation protection of the general public should be limited to reasonable regulatory controls which are comparable to other environmental hazards and health risks which are commonly experienced and accepted by the public. The goal is to find a balance between the needs of society, the health benefits gained and economic costs in money and other resources.

All of the above concensus information based on conclusions and recommendations of International Organizations has not been communicated to the public in the EPA report titled Idaho Radionuclide Study.

In addition there has been little communication of the many uncertainties inherent in the use of models, assumptions, and calculations or the use of limited Idaho field data, or extrapolated data from acute high level, instantaneous atomic weapon exposures to chronic exposures over a 70 year life span, or experimental data from animal studies extrapolated to humans. All these biological, physical and statistical variables add uncertainty to every step of the process from the dose measurements in homes to the final estimation of risk to whole populations. Combining all these uncertainties must necessarily impact the accuracy of the final risk values by factors varying from 2 to 10. Extrapolation of risks to radiation levels as low as 10 to 100 mrem/y with such high levels of uncertainty borders on speculation.

Pocatello
A MUNICIPAL CORPORATION OF IDAHO

OFFICE OF THE MAYOR
902 E. Sherman
P.O. Box 4169
Pocatello, Idaho 83205
(208) 234-6163
FAX (208) 234-6296

PETER J. ANGSTADT
Mayor

Pocatello City Council
GREGORY R. ANDE
I.J. "BABE" CACCI
ROBERT E. CHAMB
ROGER W. CHASE
KAREN A. McGEE
EARL R. POND

Public Hearing
August 21, 1990
Senate Committee on Environment and Public Works
Subcommittee on Nuclear Regulation

TESTIMONY

OF

PETER J. ANGSTADT
MAYOR

POCATELLO, IDAHO

Senator Symms, Subcommittee Members, Ladies and Gentlemen:

I very much appreciate this opportunity to address EPA's recent Idaho Radionuclide Study with the Subcommittee. The citizens of Pocatello are vitally concerned with this issue. They want to be certain that the information developed, the conclusions reached, and the policies made are as accurate and defensible as possible. Their economic well-being, general health, and simple peace of mind are at stake.

I would like to say at the outset that we do appreciate EPA being interested enough in our area to study it and determine ways to make it more healthy and desireable for our citizens. We also want to make our community a desireable place to live and work, for ourselves and our children for years to come. We don't take the concerns raised in the Radionuclide Study lightly, and we want to cooperate as best we can to remedy any significant risks that may exist.

For now, however, we are concerned about the admitted inadequacies of the Study and the conflict of opinions about it in the scientific community. The Study develops worst case scenarios based on hypothetical maximum exposures. Because expense limited the site-specific data available, the data had to be adjusted by general ratios and regression equations and some averages had to be used. Our citizens now know that the EPA considers slag to pose a very high environmental risk. But they have very little information from which to decide whether they and their families are actually at significant risk. Indeed, they are now told by a large employer in our community that actual studies of the workers who are regularly around phosphorous and its by-products show that these workers experienced less cancer than the general U.S. population.

This does not lend itself to public confidence in whether a real problem exists or what ought to be done about it.

The City has banned use of slag in present and future public works projects largely because EPA indicated that this first step was the minimum necessary to avoid a possible intervention. If the threat of low level radiation from phosphate slag is a real one, we do not begrudge such measures. But if it is not, then our citizens are being unnecessarily deprived of a construction material which is cost-productive, and unnecessarily faced with the spectre of ill-health and costs of remediation.

We want to do what is right for our citizens. We simply don't know yet what is right. It is our sincere hope that the following will result from hearings and discussions like these:

1. expeditious scientific peer-review of the EPA Idaho Radionuclide Study;

2. careful analysis of actual disease experience in the study communities and in the phosphorous industry as it relates to the risk assessment techniques of the EPA Study in order to effectively reconcile the two;

3. a consensus of opinion as to the actual health risks of slag use in public works construction and the emission of radionuclides from the phosphorous plants in question; and

4. if necessary, a reasonable remediation program which balances the economic realities of our area with any recognized risks of phosphorous by-products.

I can assure you that I and the members of the Pocatello City Council will do our utmost to assist in this process. Our concern is for the citizens, for the environment, and for the business community. Thank you very much.

DENTON DARRINGTON
DISTRICT 24
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MINIDOKA COUNTIES

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ROUTE 1
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COMMITTEES

CHAIRMAN
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HEALTH & WELFARE

Idaho State Senate

CAPITOL BUILDING
BOISE

August 21, 1990
Declo, Idaho

The Honorable Steven D. Symms
Committee on Environment and Public Works
458 Dirkson
Washington D.C. 20510

Re: Testimony on phosphate slag at the Soda Springs, Idaho mines.

Senator Symms:

Thank you for the opportunity to testify to this important issue today. We all know the importance of the phosphate industry to Southeast Idaho, Caribou County, and Soda Springs. These plants produce essential products from some of the largest and most productive phosphate deposits in the world.

With every mining operation and with every industrial business, by-products that we commonly call waste are generated.

Because the phosphate ore in these mountains contains extremely small amounts of uranium, there is a slight amount of radioactivity.

Company representatives report to me a reading of 5 millirems. It is my understanding that a reading of 500 millirems is an Environmental Protection Agency (EPA) accepted level of exposure and a reading 5,000 millirems is acceptable in the work place.

By disallowing the use of the slag from the mills in road beds and building materials, is EPA imposing a double standard? And is the standard one that is not backed by data or hard evidence that the extremely low level of radioactivity has any health hazard? If there is a health hazard EPA should immediately come forth with the facts, not inuendos, suppositions, or decisions that are the result of pressure from anti-industry extremists in or out of the Agency.

If EPA can document a significant and real hazard then what is the difference in the hazard in the use of the slag and in the hazard to the miners and plant workers here in Soda Springs?

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How many millirems of radioactivity are in your car, your household appliances, your Coleman lamp mantel, or all the items with which you have daily contact? If the reading for these items are higher than the slag, why should their use not be disallowed, if use of the slag is disallowed.

Many families live in houses where the cement includes the slag as aggregate. What do the EPA studies show? A freedom of information petition ought not be needed. The EPA should come right out and tell the citizens the results of the study. I suspect the fact is the study of the slag doesn't support the decision to disallow its use.

The EPA or any other agency need not be involved in raising fears about use of slag or any other products without hard conclusive evidence that a health risk is involved. Not only is that harmful to an industry, it also raises the spectre of liability, and we are a litiguous society, made more so by these kind of scares.

I challenge EPA and the Senate Committee should demand that the Environmental Protection Agency come forth immediately with a well-documented health hazard and apply the same standard for radioactive contamination that is applied to everything else, or give the slag a clean bill of health, permit its use, and even help find new and increased uses for this by-product. No doubt many uses may come about that haven't even been discovered.

Senator Symms, what I am asking is that the Agency be responsible and that policy is not set according to the demands of the radical extremists of the environmental movement.

Again, thank you for the opportunity to testify and good luck in demanding accountability on this slag use issue from the Agency.

Sincerely,

Denton Darrington
Senator, Dist. 24A

BAPCO Bannock Paving Company, Inc.

TESTIMONY OF MIKE WOOD
PRESIDENT OF BANNOCK PAVING COMPANY, INC.

My name is Mike Wood, President of BANNOCK PAVING COMPANY, INC. of Pocatello, Idaho. We employ between 150 - 250 employees with a payroll of over $6,000,000.00 annually.

I appreciate the opportunity to address the committee today and discuss the use of slag as an aggregate.

Since 1969 BANNOCK PAVING COMPANY, INC. has crushed and marketed slag to various users, including, State of Idaho, counties, cities and many private users throughout Southeastern Idaho, and Union Pacific Railroad in most of the Western States they operate in.

I'm not here to speak about the scientific aspect of slag or radiation, but I do have experience in the use of slag as a road building material.

Over the past 20 years we've processed and sold over 12 million tons of slag for use in area streets, highways, parking lots and as ballast to the Union Pacific Railroad. In my experience I can safely say that slag is by far the best material available for their uses and that's based on:

I. Cost: No waste, all material can be made into viable products. No drilling, blasting or hauling costs. Delivered from FMC furnaces ready to crush.

II. Performance: Durable, 100% fractured (angular), stays in place, creating less maintenance than round river rock products. Easily meets specifications for railroad ballast because of the angular nature of the crushed slag.

III. Availablity: Because we use slag we don't have to develope a gravel pit operation from farmland with all the environmental and reclamation concerns. Available year around and can be processed in off season during winter months.

In terms of impact in Southeast Idaho my entire payroll of $6,000,000.00 and the families which that supports, not to mention the State Taxes paid from that income, are all in jeopardy.

There are no local viable alternatives for railroad ballast. Alternative sources for highway and road aggregate are expensive to locate and develope and are of inferior quality in terms of efficiency and productivity and carry environmental cost with their development.

I would ask the committee to consider the devastating impact any restriction on the use of slag will mean to me and all of my employees, and to consider the benefit to residents and tax payers of Southeast Idaho that the use of slag represents.

Thank you

Phone 208/232-5786 • 10200 Batiste Road • P.O. Box 4002 • Pocatello, ID 83205-4002
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Testimony of
Suzanne Budge, Executive Director
Idaho Council on Industry and the Environment
Before the U.S. Senate Subcommittee
on Nuclear Regulation
August 21, 1990

Thank you Mr. Chairman and Senator Symms for the opportunity to present testimony on the issue of slag risk analysis.

My name is Suzanne Budge, Executive Director of the Idaho Council on Industry and the Environment. ICIE is a private, non-profit, non-partisan organization with a charter to provide factual and timely information on environmental issues in Idaho. ICIE believes that sound public policy must be based on fact and science rather than emotion, half truths and innuendos. ICIE is a member-based organization representing over 100 individuals, associations and businesses who are committed to reasonable and rational solutions to Idaho's environmental challenges.

ICIE is not an advocacy group. We do not support or oppose specific projects, issues, or legislation. However, we do advocate reliance on reputable scientific information, critical thinking, and a common-sense perspective of risks and benefits as vital to any rational decision-making process. We believe that public policy should be based on facts and documented research which originates from reputable sources and is subjected to the rigors of peer-review.

I wish to comment today on the slag issue in Southeastern Idaho. ICIE is very concerned with four aspects of the Environmental Protection Agency's recently released "Idaho Radionuclide Study." These include :

1) The assessment, or lack thereof, of the actual health risks of slag exposure;
2) The manner in which the study was brought to public attention;

3) Lack of full and free access to the raw data, the models used and the assumptions made by the EPA in the study; and
4) Lack of thorough peer-review of this study by individuals knowledgeable about the issue and who are independent of EPA.

I will briefly expand my comments on each of the four items:
First, actual health risks associated with slag exposure remain in question. EPA's Fact Sheet indicated that slag emitted radiation, but it gave no actual numbers. Anyone looking for data found the local newspapers to be the only source to show EPA estimates of an exposure level of 52 mrems/year. Fifty two mrems/year is only ten percent of the allowable radiation exposure guideline set by the U.S. Nuclear Regulatory Commission for community exposure (500 mrems/year) and only one percent of the 5,000 mrems/year limit set by the Occupational Safety and Health Administration for workplace exposure.

Average annual exposure levels range from 300 to 375 mrems, 85% of which is from natural sources, such as cosmic radiation and the food and water we consume. In fact, moving from Washington D.C. to Soda Springs, Idaho will increase annual radiation exposure by more than 52 mrem/year, simply due to the increase in elevation. Does the EPA propose to relocate entire populations in Idaho, Colorado and Utah from higher elevations to sea level to eliminate an exposure to natural radiation which is of similar magnitude? In light of natural exposure levels several times higher than EPA's estimate, and previously established national standards 10 to 100 times higher, Mr. Chairman, our question is whether slag exposure is a significant health risk at all?

Our **second** concern is with the manner in which EPA presented its findings. When the initial announcement of the study came out over a year ago, the EPA discounted the radiation from slag as insignificant. Yet, in its announcement of the completed study in May of this year, the EPA said the study *"found levels of radiation exposure that could* *cause significant health risks for some individuals."* As you can see, Mr. Chairman, there is a great discrepancy in the initial analysis of the report and the final press release.

Dramatic language is widespread in the EPA's own literature which states that *"EPA considers the situation to be quite serious,"* that *"long-term exposure to slag constitutes a definite health risk."* It referred to the issue consistently as *"the problem"* rather than the issue. You can well-imagine the reaction by the press to such strong and terrifying comments made by a federal agency. You can also imagine the confusion of residents from Soda Springs and Pocatello who, only a year earlier, were told there were no health risks.

The EPA went on to state that *"slag-contaminated foundations are the greatest single contributor to individual health risks."* and that *"EPA considers slag to pose a very high environmental risk."* Are we to assume that slag exposure ranks up there with such significant health risks as cigarette smoking, alcohol, and motor vehicles, which account for 100,000's of deaths each year? Certainly, this message is, at best, misleading.

Our **third** concern is with access to the raw data, the models used and the assumptions made by the EPA. As I mentioned before, most of the information on slag came from newspapers, hardly a valid scientific source for technical data. The EPA is apparently unwilling to release its information to either the public, the companies involved or State of Idaho officials. The only information gleaned from EPA's fact sheet was that the scientific facts were combined with *"assumptions"* to calculate probabilities and that *"these numbers represent 'ball park' estimates of the actual health risks to the citizens of Pocatello and Soda Springs."*

To make such strong statements in the press release, and then to discuss all the theoretical assumptions in the fact sheet can only confound the lay person who attempts to put the issue into some real world perspective. We would like to see the raw data, the analytical models used, and the assumptions made in deriving the relative risk of slag exposure. We would also like to know how that number fits into the bigger picture. What is the risk of slag exposure when compared with the other risks we face and accept every day? What are the risks of not using slag? How do the benefits of slag use compare to the risks? This type of information should be immediately and readily available to both health officials in the state as well as the communities these studies target. When it is not, I must assume that the information will not withstand the scrutiny of independent review.

Finally, I want to mention the necessity of independent peer-review. All statements and assessments made by the EPA should stand the scrutiny of a review process that is routine in any scientific field. EPA should be accountable for its investigation, its numbers, its methodology, and its assumptions. Any health risk study naturally requires a thorough peer review by experts who are independent of the EPA.

Mr. Chairman, Senator Symms, the treatment of the slag issue here in Southeast Idaho damages the credibility of the federal agency that is charged with providing accurate and objective scientific information on environmental issues. The very agency responsible for scientifically evaluating health risks has itself tainted an issue with emotional and biased information. To make irresponsible and possibly unnecessary comments on a potential health risk, and to cause a unfounded panic in Southeastern Idaho, is neither good policy-procedure, good information, or good judgement. As far as the Idaho Council on Industry and the Environment is concerned, this entire scenario calls into question the credibility of the EPA, it brings undue panic and possibly dire economic consequences to the residents of Southeastern Idaho and, perhaps most seriously, it diverts badly-needed resources away from the very issues in this country that pose genuine health risks.

Mr. Chairman and Sen. Symms, I appreciate the opportunity comment on this important issue. Thank you for taking the time to meet with us here in Soda Springs.

Statement of D. Warner North, Ph.D.
before the Senate Subcommittee on Nuclear Regulation
Soda Springs, Idaho
August 21, 1990

My name is Warner North. I am employed by Decision Focus Incorporated, a consulting firm in Los Altos, California specializing in quantitative analysis. I am also a part-time member of the faculty at Stanford University: consulting professor in the Department of Engineering-Economic Systems and associate director of the Stanford Center for Risk Analysis. While my academic training is in physics (B.S., Yale 1962, M.S., Stanford, 1963), mathematics (M.S., Stanford, 1966), and operations research (Ph.D., Stanford, 1970), my professional activities for the past fifteen years have been in the area of environmental risk assessment, risk management, and risk communication.

In addition to extensive consulting and research on environmental risk issues, I have served on a number of scientific advisory boards and committees. Since 1979 I have been a member of committees of the Science Advisory Board (SAB) of the United States Environmental Protection Agency (EPA). Since 1982 I have been a member, and since 1985, vice-chair, of the EPA SAB Environmental Health Committee. In 1989 I received a Presidential appointment to the Nuclear Waste Technical Review Board (NWTRB), which has oversight responsibility for the U.S. Department of Energy's program for the proposed national high-level nuclear waste repository at Yucca Mountain, Nevada. Two weeks ago President Bush reappointed me to the NWTRB for a four-year term. I am active in the Society for Risk Analysis (SRA), as a past member of its national council, as a past president of its Northern California chapter, and I am currently one of two candidates nominated for the presidency of this professional society. Over the past fifteen years I have participated in numerous studies of the National Academy of Sciences/National Research Council (NAS/NRC) concerning environmental risk issues, including *Risk Assessment in the Federal Government: Managing the Process* (1983) and *Improving Risk Communication* (1989). I am currently a member of the NAS/NRC Committee on Risk Assessment Methodology.

Given my background, I will address my testimony to the risk assessment and risk communication aspects of the EPA's *Idaho Radionuclide Study*.

My appearance in this hearing is sponsored by the FMC Corporation. I have never been employed by FMC, nor have I previously consulted to or testified on behalf of FMC. The testimony that I present is my own, and should not be interpreted as reflecting the position of FMC or any other organization with which I am now or have been associated.

The main theme of my testimony is that there is a clear need for improving risk communication and getting on with the process of risk management - deciding what to do about the slag resulting from phosphorus production. In my judgment, the EPA's *Idaho Radionuclide Study*, the fact sheet, and the press release on the study present a **distorted picture** that omits important scientific uncertainties on the health impacts of low doses of ionizing radiation.

EPA's estimate of an increased cancer risk from slag is theoretical. As the other speakers on this panel will indicate, there is no evidence from epidemiological investigations of human populations that exposures to doses of ionizing radiation within a factor of two or so of background levels lead to **any** increase in the incidence of human cancer. The calculations that EPA has made of increased cancer risk are based on an **extrapolation** of the cancer incidence from **high** doses of radiation, such as those experienced by the survivors of the nuclear bombings at Hiroshima and Nagasaki, to a prediction of a small increase in cancer incidence from **low** doses of radiation. The increased radiation from exposure to slag in Soda Springs and Pocatello is within the range of variability of background radiation from cosmic rays (for which exposure varies with altitude) and naturally occurring minerals that contain low levels of uranium and thorium. The predicted changes in cancer incidence are too small to be observable in human health studies.

EPA's 1986 *Guidelines for Carcinogen Risk Assessment* advocates the use of a linearized multistage procedure for calculating cancer incidence from low-dose exposures. For the *Idaho Radionuclide Study* EPA used a linear model, but not according to the prescription set forth in its guidelines. These guidelines state that the resulting estimate is

> a plausible upper limit to the risk that is consistent with some models of carcinogenesis. Such an estimate, however, does not necessarily give a realistic prediction of the risk. The true value of the risk is unknown, and may be as low as zero. The range of risks, defined by the upper limit given by the chosen model and the lower limit which may be as low as zero, should be explicitly stated.

Federal Register, *51*:33998 (1986)

EPA's statements of the probability of contracting cancer due to exposure to phosphorus slag in the Forward, the Statement of Findings, and the main text and tables of the *Idaho Radionuclide Study* consistently violate its own guidelines. **EPA's risk results should be restated that the increased cancer risk could be as low as zero and as high as the numbers that have been calculated.**

In other respects, as well as the statement of the numerical risk results, the EPA report and the press release do a poor job of communicating about risks. One statement in EPA's May 31 News Release seems particularly egregious:

> Long-term exposure to slag constitutes a definite health problem. We believe that the future use of slag in roads and construction should be banned.
>
> EPA News Release, May 31, 1990, page 1

There are several problems with this statement. First, it is misleading to state that radiation exposure from slag constitutes a definite health problem. There is no observational evidence, either from slag or from other exposures to low levels of ionizing radiation, that the levels present in Pocatello or Soda Springs induce cancer in humans. Rather, EPA has used a theoretical model to project a potential increase in cancer at a level that is a very small fractional increase over the background cancer incidence rate. The second problem is that EPA's spokesman has then advocated a risk management policy: banning the future use of slag in roads and construction. Leaving aside the issue of the legal basis for such a ban, the ban would make sense only for situations where there is substantial human exposure. For some construction and road use, the human exposure will be so low that the risk entailed by continued use of the slag is clearly inconsequential.

The NAS/NRC Report, *Improving Risk Communication*, provides a number of conclusions and recommendations that EPA would do well to follow in dealing with the phosphorus slag issue and in similar situations that it may encounter. I will briefly summarize major points with reference to both the EPA study and the NAS/NRC report.

1. EPA's report neglects the uncertainty in estimating the low-dose impacts of ionizing radiation on human cancer. The assumed linear relation between radiation dose and cancer incidence is stated in one sentence on page 36 of the EPA report, without even a citation to authoritative sources (such as the NAS/NRC reports on the Biological Effects of Ionizing Radiation: BEIR III, BEIR IV, and BEIR V). In these sources the interested reader will find discussion of the uncertainty in the extrapolation of cancer incidence from high doses to low doses, and the many unconfirmed assumptions on which such extrapolation depends. The Forward to the EPA report notes that if the recently released BEIR V predictions of cancer incidence from the Hiroshima-Nagasaki data were used, the estimated cancer increase would be approximately twice as high as the figures EPA has used. It is also noted in the Forward that the phosphorus industry in Idaho is only about 35 years old, so that lifetime exposures could not have occurred and the projections of cancer incidence today will be lower than the risks EPA has calculated. But if present usage patterns for slag continue, "these risk levels will be reached in forty years." The reader might get the erroneous impression that all the important caveats have been provided. To

the contrary, EPA has not mentioned the many sources of uncertainty and has not attempted to summarize the many caveats on low-dose extrapolation in BEIR V, BEIR III, and other recent scholarly summaries on the health risks of ionizing radiation. **In a report of nearly 50 pages, EPA should spend at least a page informing the reader of the uncertainties in the projection of cancer incidence from low-level exposures to radiation.** The general principle is given in the 1989 NAS/NRC report:

> Risk messages and supporting materials should not minimize uncertainty. Data gaps and areas of significant disagreement among experts should be disclosed. Some indication of the level of confidence of estimates and the significance of scientific uncertainty should be conveyed.

Improving Risk Communication, p. 170

2. EPA should have worked with Idaho agencies and the interested parties in the local community in the preparation of the report. EPA prepared a detailed analysis of risk and presented it to the affected parties with little opportunity for them to participate on the goals, scope, or content. As prescribed in the NAS/NRC report,

> Risk communication is an interactive process of exchange of information and opinion among individuals, groups, and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions, or reactions to risk messages or to legal and institutional arrangements for risk management.

Improving Risk Communication, p. 21, 26, and 74

EPA has expressed its intention to work with Idaho agencies and the affected parties in Soda Springs and Pocatello to deal with the slag issue. EPA should deliver on this promise and practice risk communication as an interactive process.

3. EPA should have had its risk assessment peer reviewed. In particular, the raw data from the surveys of Soda Springs and Pocatello should have been made available for scrutiny and review prior to publication in a formal report. Peer review of EPA's report was alleged, but in fact all the EPA Science Advisory Board Radiation Advisory Committee did was to review a work plan (memorandum from Kathleen Conway, June 22, 1990). As will be noted in the testimony of subsequent speakers, there appear to be a number of technical flaws in EPA's work. *Improving Risk Communication* strongly advocates the use of independent peer review (p. 156, 158-9).

4. EPA's Report provided very little information on the risk management context. *Improving Risk Communication* notes that the goal of risk communication is to achieve well-informed decisions, and it devotes a section (p. 174-75) to ensuring completeness in the risk communication process. A risk message checklist is provided on p. 175 of this report, not as a rigid set of required elements in risk communication, but as an aid to assure that important aspects have been considered. EPA's report deals incompletely with the first category on this checklist, the nature of the hazard, and ignores the subsequent categories: the nature of benefits, the alternatives, the uncertainties in knowledge about risks, and information on management. EPA should do much more to provide information to the affected communities regarding risk management for slag.

5. Are the risks posed by radiation from slag acceptable? It seems to me that this determination should be made by local people, who are given the opportunity to become well-informed about the level of radiation from slag and the health consequences of this radiation. Experts from EPA, Idaho state agencies, the academic community in Idaho, and Idaho industry (including the Idaho National Engineering Laboratory) might all contribute to helping the public become better informed about this issue. *Improving Risk Communication* gives the purpose of risk communication as "'to inform the discretion' of government officials, private organizations, and individuals" (p. 26) and cites Thomas Jefferson:

> I know of no safe depository of the ultimate powers of society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion. (Thomas Jefferson, letter to William Charles Jarvis, September 28, 1820).

Improving Risk Communication, p. 14

COMMENTS ON EPA'S RISK ASSESSMENT FOR PHOSPHATE SLAG

Dr. Herman Cember

Thank you Mr. Chairman.

As you have already noted, I am Dr. Herman Cember, and currently am a Professor of Environmental Health at Northwestern University. I am a certified health physicist and a registered professional engineer. I have spent my professional life teaching and practicing radiation protection, and in researching the biological effects of radiation exposure. I have written numerous papers on this subject and I am the author of the most widely used health physics textbook. I believe that my background qualifies me to comment impartially on the radiation exposure assessment developed by the Environmental Protection Agency in the Idaho Radionuclide Study of Soda Springs and Pocatello, Idaho.

The main points that I wish to make in this presentation are:

1. That risk assessment is a highly subjective, theoretical mathematical exercise that inherently contains numerous uncertainties, and

2. That the EPA's risk analysis notwithstanding, every bit of real data on human health effects of radiation shows that there are no health risks associated with the radiation doses in Soda Springs and in Pocatello.

Risk Assessment deals with the estimation of the probability or occurrence of an unlikely event, and it consists of two different processes:

1. Risk estimation
2. Risk evaluation

In risk estimation, we determine the numerical value for the chances of the occurrence of the unlikely event, and in risk evaluation we try to evaluate the significance of the estimated risk in the context of other risks that we, either as individuals or as a society face. It is not intended to predict the number of deaths following a specific low exposure; it is intended to serve as a guide for public policy in the setting of environmental safety standards.

In the case of environmental radiation, the estimation of risk seems to be objective and "scientific," since it is based on laboratory studies and on epidemiological data. The evaluation of the risk is a lot more subjective, and includes societal and personal values as well as numerical probabilities. (For example, death or serious injury from traffic accidents are acceptable by society and are considered to be one of the normal risks of everyday life. We also perceive the death of a child from cancer differently from that of a 70 year old cancer victim). Although we perceive the risk assessment process as being objective, there are in fact a number of uncertainties and subjective decisions that enter into the risk assessment process. These uncertainties include the validity of the model chosen for extrapolation from high doses and high dose rates to low doses and low dose rates, extrapolation from animal species to humans, and consideration of other factors that may influence the outcome of a given exposure (such as smoking).

An enormous amount of data are available for radiation risk estimation. Contrary to the widespread popular belief that we know little about the effects of ionizing radiation, we probably know more about the effects of ionizing radiation than the effects about any other noxious agent to which we may be exposed. The Japanese and American group of scientists and physicians who are studying the survivors of the nuclear bombings in Hiroshima and Nagasaki, to date have found no increase in leukemia among survivors whose doses did not exceed 10,000 millirems. Recall that the average exposure, according to the EPA's estimates, are 52 millirem per year in Soda Springs and 14 millirem per year in Pocatello. Because we have no data from any other sources showing that radiation exposure at these low dose levels leads to an increased probability of cancer, we resort to mathematical techniques for extrapolating the cancer dose - response relationship to doses less than 10,000 millirems. An alternative to extrapolating to lower doses is simply to say that there is a threshold at 10,000 millirems, and that the risk below this dose is zero. However, regulatory agencies do not do this because the most conservative biological model for cellular changes that may lead to cancer induction assumes that even a single hit in the DNA molecule can initiate the series of events that leads to a cancer. For this reason a zero threshold linear dose-response model for carcinogenes is postulated, and it is assumed that any exposure carries some risk. I must emphasize here that we have no biological evidence to verify these assumptions. According to this model, the EPA risk calculation shows that the maximally exposed individual in

Soda Springs incurs a risk of 6 in 1,000 of dying from cancer as a result of his or her exposure. The maximally exposed individual in the EPA calculations is defined as a teenager who spends most of his or her time over a 70 year period in the basement of a home whose foundation is made of slag. If we consider all the people in Soda Springs rather than the maximally exposed individual, then the EPA calculation postulates 0.1 cancer death per year (one death every 10 years) among the 3,800 inhabitants of Soda Springs based on an average dose of 52 millirem per year.

The doses under discussion in the case of the Soda Springs and Pocatello population are within the range of variation of the background radiation in the United States and in other countries of the world. Background radiation includes contributions from cosmic radiation, whose intensity varies according to altitude and latitude and terrestrial radiation from naturally occurring radioactive materials, whose intensity varies according to the mineral content in the ground. A person in Chicago, for example, receives an annual dose of about 100 millirem from background, while a person in Denver receives a dose of about 200 millirem in one year. We have never found any leukemia or any other type of cancer among any population that could be attributed to increased background radiation.

Other groups of people that may serve as a yardstick in evaluating the health effects of the radiation levels in Soda Springs include radiation workers. A number of studies involving many thousands of radiation workers have shown the observed cancer rate to be about 85% of the cancer rate expected on the basis of the cancer rates in the general population. The radiation doses to these workers are on the order of hundreds of millirem per year. The findings to date are consistent with the hypothesis that doses on the order of background variability do not result in an increase of the cancer rate. The BEIR Committee of the National Research Council, in the BIER V Report, explicitly recognized this by saying: "Thus the possibility that there may be no risks from exposures comparable to external natural background radiation cannot be ruled out. At such low doses and dose rates, it must be acknowledged that the lower limit of the range of uncertainty in the risk estimates extends to zero."

In summary, I believe that the population doses in Soda Springs and in Pocatello are so low that they do not pose any health threats.

STATEMENT OF JOHN A. AUXIER, PH.D., CHP

"Thank you, Mr. Chairman."

"As you noted, I am John A. Auxier, Ph.D., CHP and am presently serving as Corporate Manager of Nuclear Sciences at IT Corporation. I received my doctorate in health physics from The Georgia Institute of Technology, Atlanta, Georgia in 1972, and have dedicated my professional life to the study of the health effects of radiation exposure. I have authored and coauthored numerous publications in this regard, including the report of the Dosimetry and Health Physics Task Group of the Presidents Commission on the Accident at Three Mile Island. Other articles include "Physical Dose Estimates for A-Bomb Survivors - Studies at Oak Ridge U.S.A.", J. Rad. Res. 16. Supl 1-11, and "Local Dose Neutron Produced Recoil Ions in the Region of a Therapeutic 252-Cf Needle" Radiology 105:187-189., which are regarded by the scientific community to be fundamental to the study of radiation exposure assessment. I believe my background qualifies me to fully and impartially comment on the radiation exposure assessment developed by the Environmental Protection Agency in the Idaho Radionuclide Study of Soda Springs and Pocatello, Idaho."

Comments on the Risk of Using Phosphate Slag for Construction and Surfacing Materials:

Ionizing radiation can be harmful and is a known carcinogen at high doses and dose rates. Ionizing radiation is part of our natural environment and is not known to be harmful at or near environmental levels. Many activities displace or relocate naturally radioactive materials. This may alter the local radiation levels, but these activities usually do not alter the local radiation exposures to levels of known risk. The National Council on Radiation Protection and Measurements stated in a recent publication, NCRP 93, 1987, that dose reduction "...would not be feasible or cost effective in the case of building materials or mining and agricultural products."

The degree of protection afforded by current ionizing radiation standards has recently been questioned in the media, largely because of the publicity surrounding the publication of the report of the BEIR V committee. The popular interpretation of the report is that ionizing radiation may be 2 to 4 times more harmful than previously thought. It should be noted, however, that the BEIR V committee relied to an unprecedented extent on a single exposure situation, the survivors of the bombings of Hiroshima and Nagasaki. While this data base is unquestionably the most important single set of information available, exclusive reliance on this one study leaves the committee findings overly vulnerable to any errors or omissions in its dosimetry or epidemiology. For example, the BEIR V committee noted that extensive experimental and human data indicated that doses delivered slowly had less effect than doses delivered instantaneously. Yet the BEIR V model is based on high doses delivered instantaneously. The committee noted that the low dose rate data showed reduction in the effectiveness of the radiation to do harm by a factor of 2 to 10 but this factor does not appear in the conclusions.

Previous BEIR committee reports made more extensive use of other exposure situations, gaining breadth in the process. In my opinion, it is unfortunate that the BEIR V committee did not place greater emphasis on data from studies of other exposure groups that more closely relate to the low dose, low dose-rate situation we are now considering. I believe it is appropriate to consider risk estimates derived from BEIR III as well as those derived from BEIR V, at least until such time as some of the current controversies surrounding BEIR V are resolved.

The BEIR V committee noted that the model it used gave the highest results of all proposed models. The committee stated further that model predictions are 25% uncertain, and that the application of the model to the data included further uncertainties such that the prediction of risk at low doses included zero risk. Stated differently, the model as a calculational device does not calculate risk exactly, but probably within 25%, _if_ the model applies. Since the model may not apply in the low dose range, any risk assessment must recognize that zero risk is a possible outcome of a low exposure. The committee concluded that application of the model to the data did not exclude the existence of a threshold dose, below which the risk is zero.

The range of background radiation worldwide is quite large. There have been no effects observed for populations subjected to background radiation. Background in the United States varies geographically with soil and rock type and with altitude. The altitude effect is about half a mrem per year for each 100 feet of elevation. A person who, for example, relocates from a coastal region to Denver increases his annual cosmic ray dose by about 30 mrem. The increase in terrestrial gamma radiation accompanying such a move is even more significant, but is subject to considerable local variation. In a number of places in the world, the natural background is notably higher than in our mountain west, and such places have been subjected to epidemiological scrutiny. In Kerala, India where a population of

100,000 people has existed for centuries, the dose-rate varies from a low of about 300 mrem per year to a high of 2800 mrem per year with a population average of about 500 mrem per year. No harmful effects have been observed in this population. The observation of no effect at this exposure level provides grounds for questioning whether BEIR V's conclusions are applicable to the exposure conditions we are now discussing.

The exposure to background radiation is an involuntary risk, if a risk exists. A person concerned about this risk could lower the risk by actively lowering his/her exposure to background radiation, most readily by moving to a low background area. The public is usually concerned about involuntary risks that are imposed by others while often accepting higher risks because they are voluntary. An involuntary risk could be pollution from a factory, while a voluntary risk might be the choice of not using seat belts while driving a car, or even driving a car. The use of slag in construction and surfacing materials could be a voluntary risk since the availability and cost make them desirable compared to mining and long-distance transport. The total risk of using slag may be less than all alternative materials since the radiation risk is zero or nearly zero.

Figure 1 shows some actual annual radiation exposure rates and three proposed or adopted limits for exposure to the general population. The natural background external radiation rates span an order of magnitude from approximately 50 mrem per year for U.S. coastal plain locations to 500 mrem per year for the average resident of Kerala. This rate also happens to be the exposure limit, above background, for the general population currently in force in this country. The general population exposure limit is one-tenth the limit of radiation workers, a group among which we have also observed no effects. In some surveyed areas, such as Denver, the external background averages about 90 mrem per year higher than in the coastal plain. This difference is illustrated by the bar labelled "Denver Increment". This increment is only a little less than the NCRP 91 recommended limit of 100 mrem per year to the general population. Language specifying limits "above natural background" notwithstanding, the body has no way to distinguish between background radiation and radiation due to technological activities. Clearly, NCRP 91 goes about as far as we can go without being scientifically inconsistent, economically foolish, or perhaps both.

The average exposures reported for Soda Springs in the "Idaho Radionuclide Study" (EPA/520/6-90/008) are also presented in Figure 1. Taking those numbers for the moment as reported, we see first that the average net exposure is about half that of the "Denver Increment", while the rate on driveways is only a little higher than that increment. The average net first floor exposure rate is a bit less than the average natural background in the U.S. coastal plain, and considerably less than that in the Denver area.

Although assigning risks as to categories of voluntary or involuntary can be subjective and open to debate, I have used this mechanism in Figure 2 which compares risks from slag to levels of risk from various common activities. The estimated risk of smoking two cigarettes per day for life is about 20% higher than the EPA's estimate of the risk corresponding to the average level of radon in U.S. housing. The risk corresponding to the EPA screening level of 4 pCi/l is five times as high. Smoking is a voluntary risk, as is riding in a motor vehicle. Voluntary risks such as these are shown as shaded bars in figure 2, while involuntary risks are shown by unshaded bars. Air pollution in the eastern U.S. is an involuntary risk that has been estimated to be nearly as high as the motor vehicle rate[1]. The frequent flyer runs about 3500 chances in a million of dying in a crash, provided he flies for 70 years and doesn't die from smoking or air pollution first. Taking the numbers from the Idaho Radionuclide Study, uncorrected, and applying the lifetime risk factors in BEIR V, we obtain a predicted risk a bit less than the frequent flyer's and about a tenth of the theoretical risk from having an average amount of radon in the home. Applying what I believe to be the more relevant 3EIR III factors, we are down in the range of sending the kids off to school with a couple of peanut butter sandwiches every day.

The current estimation of risk of using slag for construction and surfacing material uses a conservative high dose and high dose rate model. This application of the model is most likely beyond the validity of the model according to the BEIR V report. The risks projected, nevertheless, are much lower than common voluntary risks. Much of the risk estimation was based on aerial measurements. The aerial measurements are well done and show clearly the presence of slag based materials in the communities. The aerial measurements have a disadvantage of averaging over a wide area because the detectors have a wide field of view. This field-of-view averaging exaggerates the area affected and extends a higher average over the indicated area. The result is that mean dose to people may be overestimated by 2 or more. Ground-based measurements indicate that exposure is restricted to the immediate vicinity of the slag and that the average dose to an area is less than half that indicated by the aerial measurements. Even with this over estimate, the doses are acceptable and pose no threat to the community. The doses are well within the range of natural background and the variation of background within the communities.

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[1] Risk estimates in Figure 2 are drawn primarily from "Carcinogen Risk Assessment" C.C. Travis, ed., Plenum Press, 1988.

It should be noted that the gamma radiation exposure rate in some well known public structures such as New York's Pennsylvania Station is several hundred millirems per year. Recent measurements made in the Rotunda of our national Capitol average 115 millirem per year and similar measurements in the EPA headquarters (mall entrance) average 46 millirem per year.

The risk to the populations of Pocatello and Soda Springs due to the radioactivity in slag are, in my opinion, zero. Actions to reduce exposures from construction and surfacing materials are not warranted. Discontinuation of their use is not recommended, especially if other materials increase the risk to the population through transport and mining risks. Other social and economic benefits should be considered before discontinuation is recommended. The conclusion in NCRP 93 should be heeded that dose reduction "...would not be feasible or cost effective in the case of building materials or mining and agricultural products".

Patrick R. Conner, M.D.
Monsanto Company
Testimony before the U. S. Senate Environment and Public Works Committee,
Subcommittee on Nuclear Regulation
Soda Springs, Idaho; August 21, 1990

I thank Senator Symms for this opportunity to more fully discuss a number of issues which have caused the public great anxiety over the past few months...issues which go beyond mathematical formulas and look at real effects on real people. My presentation is aimed at providing facts which I hope everyone concerned will find helpful in assessing the questions surrounding the issue of whether or not the presence of elemental phosphorus slag in the communities of Pocatello and Soda Springs presents a significant risk to the future health of the citizens of both of those towns.

You have already heard a great deal about risk assessment procedures and radiation protection practices, their proper use and, unfortunately, their occasional misuse. I would like to provide you information on what we have been able to measure about the human health effects of the low level exposures we are talking about in Pocatello and Soda Springs.

You have probably already heard that both cities and the counties in which they reside have low cancer rates compared to the rest of the country. Since EPA is expressing its greatest concern for the exposures in Soda Springs, I would like to present figures specifically for Caribou County. You will note in the first chart, the Caribou County statistics, represented by the clear bars, are lower than the national average for every decade, and lower than the state average for almost every period[1]. In fact, during the period 1980 -'87, the Caribou County cancer mortality rate is about half the national average and appears to be falling[2].

The second chart provides leukemia information for the same periods and locations. Leukemia is the malignancy that was most clearly and closely associated with the radiation exposures from the atomic bombs in Hiroshima and Nagasaki[3]. Please note that EPA is primarily extrapolating from this one time, extremely high dose event to come up with its risk assessments in southeastern Idaho. Leukemia may serve as a sentinel malignancy because it was the first malignancy to show up and its incidence peaked within 10 years of the bombs being dropped[3]. Again, you will notice the leukemia rates for Caribou County are declining, and, for 1980 - '87 appear to be about half the state and the national cancer rate.

Slag has been sold by FMC and Monsanto in both of these communities since the early '60s. If exposure to radiation from slag in either of these cities was causing a major increase in leukemia, that effect would be showing up on this chart by now. Actually, just the opposite is true.

Let's move on and see what epidemiology has been able to show us in more highly exposed populations. FMC has been examining its own work force for more than a decade as part of its occupational health protection program. Their most recent study covers all employees who worked at their Pocatello plant for at least one year between 1949 and 1987[4]. This is an extensive study including nearly 1,900 individuals with a total of more than 18,800 person-years of exposure to work in the plant. The investigation's most striking finding is that cancer rates in FMC's employees do not increase with increasing length of employment. You certainly would expect the opposite to be true if exposure to slag were causing cancer in this Occupationally exposed population.

An even larger and more significant study was published last year by a group of prominent epidemiologists who investigated three federal nuclear weapon facilities[5]. The study involved almost 36,000 workers with over 700,000 person-years of exposure. Cumulative doses ranged from zero to well over 20,000 millirems. The average exposure to this very large study population was 3,100 millirems. The average length of follow-up for all of these workers was 21 years in two of the facilities and still a considerable 14 years in the other. Remember, the latency period for leukemia, the most sensitive form of cancer to radiation, was ten years in the atom bomb experience. Length of follow-up in this study should have been more than adequate to detect any effect in these populations.

Not only was no increase in total cancer rate detected, but there was actually a slight decrease with increasing exposure. The same held true for leukemia. Again, the trend for leukemia rates with increasing dose in this huge study population was negative, that is , a slight decrease in the rate of the development of leukemia with increasing cumulative dose of radiation.

Mother nature provides us with further clues. Naturally occurring variations in background radiation do not appear to affect the cancer rates in human populations. One particularly relevant study compared aerial survey data of the entire state of Connecticut with the world's best data on cancer incidence in humans, the Connecticut Tumor Registry[6]. It turns out that cancer rates in Connecticut do not vary in relation to levels of background radiation. This negative finding is particularly significant since this state in general has a high level of background radioactivity and the variation across the state is two fold. Please remember that the average increase in exposure estimated by EPA for the citizens of Soda Springs is only fifty per cent above background[7].

The bottom line is that the available evidence on humans does not demonstrate adverse health effects at dose levels we are talking about in Soda Springs and Pocatello from exposure to slag.

To summarize, I would like to point out that the risk figures EPA has broadcast are only hypothetical projections. They are not scientifically measured facts. Meanwhile, **THE ABSOLUTE FACT** is that such estimates have a range of uncertainty around them. **THE FACT** is that the true risk from exposure to the radioactivity in slag in both communities may be zero.

Senator Symms, I must stress that any action EPA proposes carries psychological, sociological and medical costs even when a benefit to its action is clear and demonstrable. In this case, however, EPA itself has repeatedly stated that it will never be able to measure the benefit they have hypothesized. Meanwhile, the citizens of Soda Springs and Pocatello have clearly and eloquently expressed the harm they fear from the Agency's pronouncements that they and their neighbors are at an increased risk of dying from cancer.

Senator, the ultimate ethical maxim in the practice of medicine is above all do no harm. I implore the Environmental Protection Agency to follow that adage. They must act as responsible and effective physicians for the environmental health of all of us; omitting nothing that impacts the welfare of these communities from their considerations.

ALL CANCER MORTALITY - MALES

	1950-59	1960-69	1970-79	1980-87*
Caribou Co.	144.3	134.2	149.0	96.8
Idaho	139.8	151.8	166.3	176.6
U.S.	176.6	190.0	204.1	211.6

LEUKEMIA MORTALITY - MALES

	1950-59	1960-69	1970-79	1980-87*
Caribou Co.	2.0	10.3	6.0	3.9
Idaho	8.8	10.2	8.9	8.4
U.S.	8.5	9.5	9.1	8.6

ALL CANCER MORTALITY - FEMALES

	1950-59	1960-69	1970-79	1980-87*
Caribou Co.	53.1	130.4	92.3	81.9
Idaho	120.0	112.8	111.9	121.3
U.S.	141.6	132.4	131.7	136.3

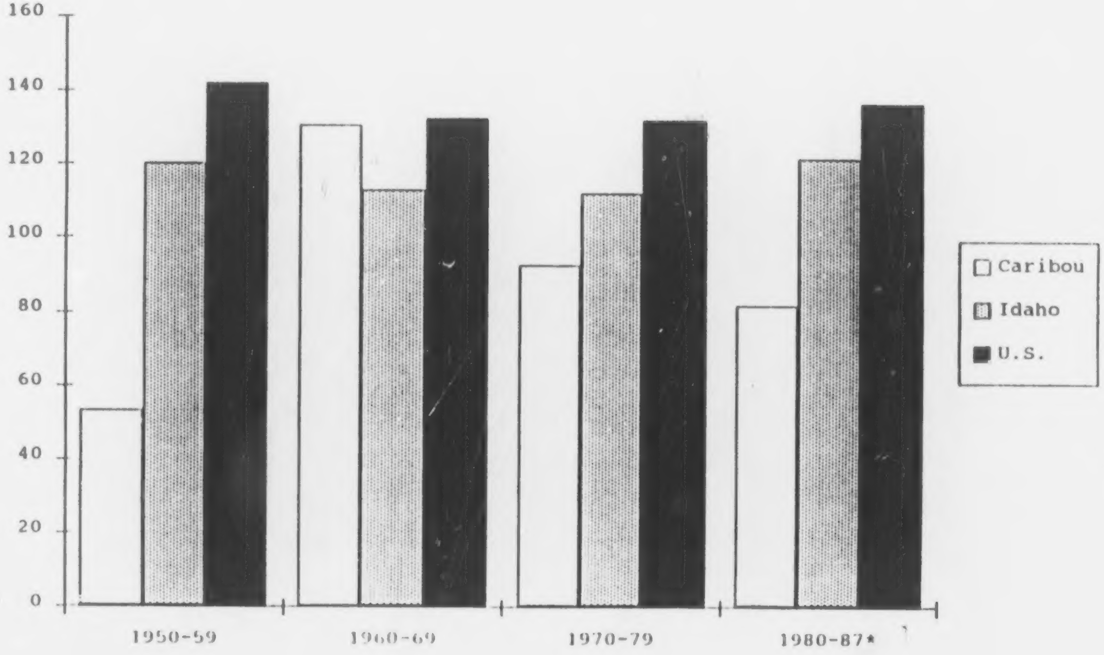
LEUKEMIA MORTALITY - FEMALES

	1950-59	1960-69	1970-79	1980-87*
Caribou Co.	5.4	3.4	5.0	2.6
Idaho	5.8	6.2	5.2	5.4
U.S.	5.7	5.9	5.4	5.1

Sources: U. S. Cancer Mortality Rates and Trends, EPA/NCI. (Sept/'83)

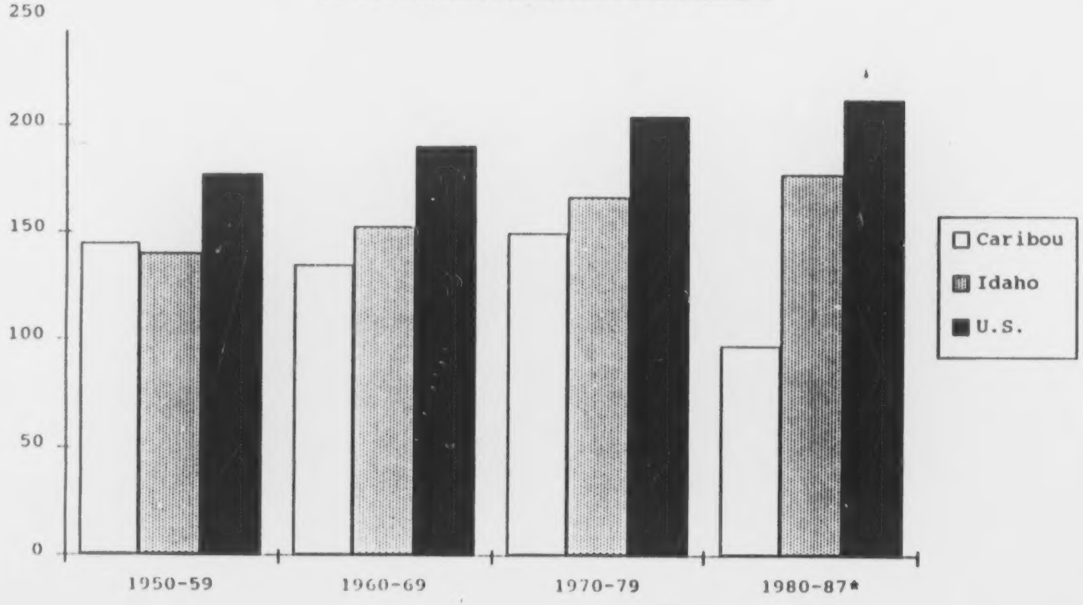
** Mortality & Population Data System. U. of Pittsburg, Dept of Biostatistics.*

AGE ADJUSTED CANCER MORTALITY
PER 100,000
WHITE FEMALES 1950-'87



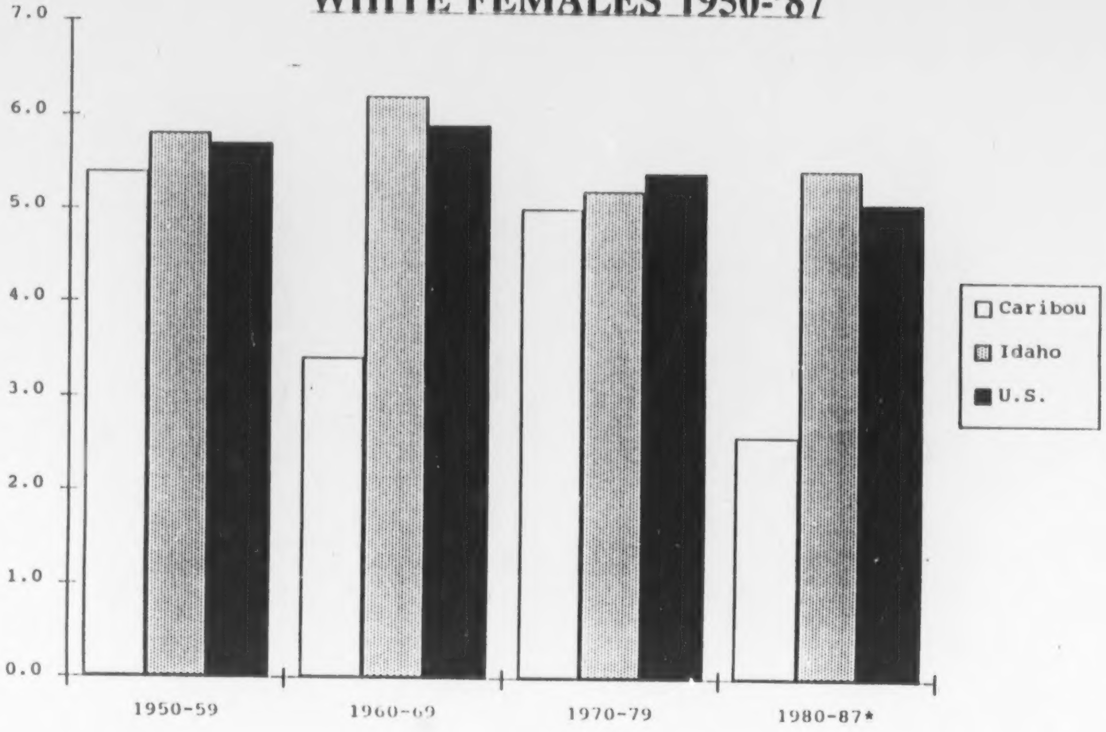
Sources: U. S. Cancer Mortality Rates and Trends, 1950-1979 EPA/NCI, Sept. 1983.
* Mortality & Population Data System U of Pittsburg, Dept. of Biostatistics & Epidemiology, 1987

AGE ADJUSTED CANCER MORTALITY
PER 100,000
WHITE MALES 1950-'87



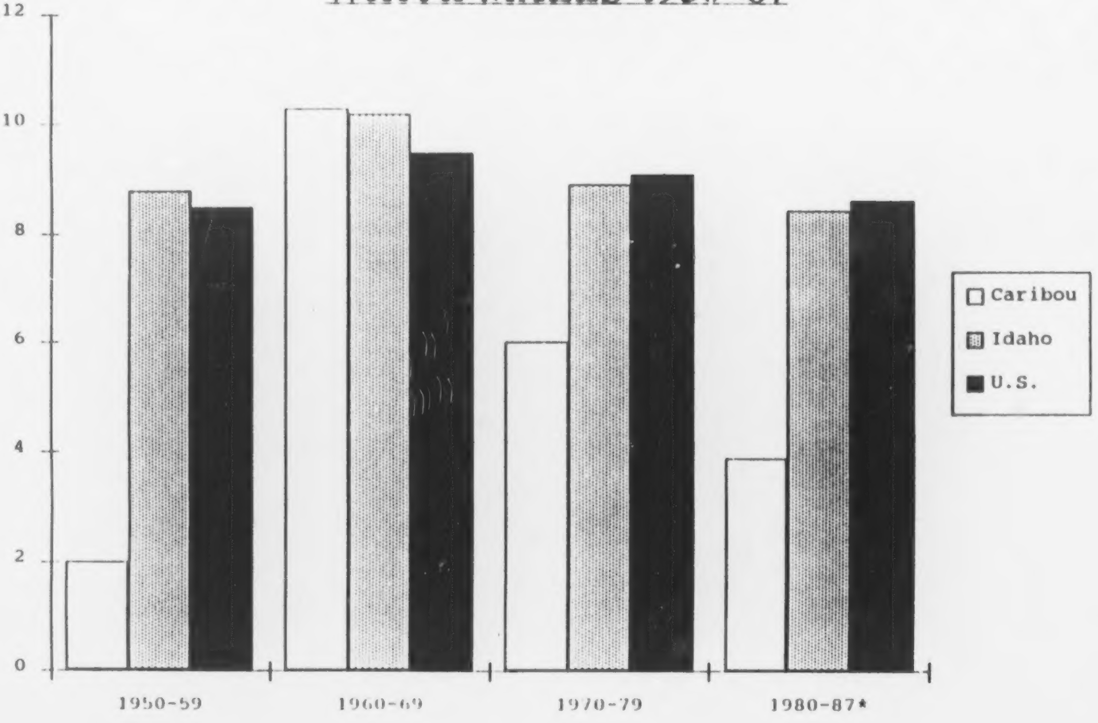
Sources: U. S. Cancer Mortality Rates and Trends. 1950-1979 EPA/NCI, Sept 1983
* Mortality & Population Data System U. of Pittsburg, Dept. of Biostatistics & Epidemiology, 1987.

AGE ADJUSTED LEUKEMIA MORTALITY
PER 100,000
WHITE FEMALES 1950-'87



Sources: U. S. Cancer Mortality Rates and Trends, 1950-1979. EPA/NCI, Sept. 1983.
* Mortality & Population Data System U. of Pittsburg, Dept. of Biostatistics & Epidemiology, 1987.

AGE ADJUSTED LEUKEMIA MORTALITY
PER 100,000
WHITE MALES 1950-'87



Sources: U. S. Cancer Mortality Rates and Trends, 1950-1979 EPA/NCI, Sept. 1983.
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1) U.S. Cancer Mortality Rates and Trends, 1950-1979. EPA/NCI, Sept. (1983)

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4) Shindell, S. and Ulrich, Slack. "Report of Epidemiologic Study, July 1949 - March 1987" for FMC Corporation, Phosphorus Chemicals Division, Pocatello, Idaho. Ergotopology, 823 No. 2nd St., Suite 413, Milwaukee, WI. (5/12/'88)

5) Gilbert, Ethel S. et al. "Analyses of Combined Mortality Data on Workers at the Hanford Site, Oak Ridge National Laboratory, and Rocky Flats Nuclear Weapons Plant." Radiation Research vol 120, pp 19-35 (1989)

6) Walter, S. D. et al. "The Relationship of Cancer Incidence to Terrestrial Radiation and Population Density in Connecticut." Am. J. of Epidemiology. vol. 123, no. 1, pp. 1-14. (1/'86)

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Comparative Risk Assessment for the Use of Phosphate Slag in Surfacing and Construction Materials

J. L. Alvarez
IT Corporation
August 1990

Introduction

Phosphate deposits contain uranium series radionuclides in concentrations greater than natural background levels. These radionuclides are distributed among the products, by-products, and wastes when the ore is mined and processed. The wastes are eventually returned to land surfaces resulting in locally enhanced concentrations of natural radionuclides. Slag from the thermal process to produce elemental phosphorous is a low-porosity material of uniform strength that is particularly attractive for construction and surfacing materials.

The phosphate industry is neither regulated nor monitored for the possession, use, or discharge of radioactive materials associated with phosphate rock and its products and by-products. The State of Idaho prohibits the use of slag, since June 1, 1977, from use in habitable structures. There is no prohibition to the use of slag for road construction, railroad ballast, and other general purposes. The Environmental protection Agency (EPA) has collected data on phosphate effluents and wastes in order to evaluate exposure and risks to populations and individuals(2). The most recent document is the Idaho Radionuclide Study (3) which includes exposure estimates and a worst-case risk assessment.

A comparative risk assessment is needed which critiques the EPA risk assessment and evaluates the EPA exposure estimates. A perspective must be established that defines the limits of possible exposures and contrasts the actual risks to the usual practice of risk evaluation.

This risk assessment covers gamma exposure only from slag-based construction and surfacing materials. It is not concerned with airborne or waterborne radionuclides, because the slag-based materials are not expected to release radionuclides by the water or air pathways because of the slag's chemical and physical form.

Exposure Levels and Geometries

The potential exposure from slag is the result of gamma radiation emitted by the radionuclides of the uranium series. The exposure that results from this same series in the soil is 2 uR/hr per pCi/g of ^{226}Ra (4). The slag can be assumed be the same density and composition as soil allowing the same conversion factor. Slag having ^{226}Ra at 30 pCi/g will have an air exposure rate resulting from the uranium series of 60 uR/hr one meter from its surface. The slag at the Pocatello, Idaho FMC plant is reported to have a ^{226}Ra concentration of 23 pCi/g by FMC personnel and 35 pCi/g by Boothe (5). A 10 cm thick layer is approximately equivalent to an infinitely thick layer and would be expected to deliver the maximum exposure rate if it were pure slag. Slag mixed equally to a 10 cm depth with soil that contains the natural average of 1 pCi/g of ^{226}Ra would deliver the average exposure rate of 32 uR/hr if the slag contained 30 pCi/g. The total exposure rate would be about 42 uR/hr when other natural radiations are included. Asphalt and concrete containing slag can be treated similarly, the exposure rate resulting from the average pCi/g of the mixture. (Concrete is denser than soil which results in lower exposure rates than soil.) Boothe measured exposure rates above asphalt of 9-37 uR/hr. The author measured values from 12-40 uR/hr.

The geometry of the slag used in surfacing and construction determines the extent and intensity of the exposure. A roadway is both a slab and a line source, depending upon the location of the point of exposure. Exposure is usually measured 1 meter from a surface. The exposure above the roadway should be the same at any position 1 meter above the roadway except near the edges, if the roadway is composed of uniform material. As the point of exposure moves away from the roadway, the distance to the source increases and the angle from the normal to the road surface increases. These two decreasing effects are multiplicative. The distance from the roadway causes a decrease that follows approximately the inverse of the distance, while the angular dependence follows the cosine of the angle. The exposure, 1 m above the surface and 15 m from the center of a 10 m wide roadway would be expected to be 1/15th times the cosine of 86 degrees or 4 thousandths of the exposure at the center line of the roadway. If the roadway were on edge as a wall, the decrease would be approximately the logarithm of the inverse square of the distance. The exposure, 15 m from a wall, would be approximately 3 times less than 1 m from the wall. The consequences of these geometries are that for slab type exposures, the exposure is restricted to the immediate vicinity of the slab, but for wall type exposures the exposure rate may be appreciable for some distance from the source. These two exposure geometries present the extremes for doses from slag exposure. Consequently, two extreme examples of possible exposure situations can be proposed that define the upper and lower limits of dose from slag-based materials. Assume a person is confined because of illness to a house located 15 m from the center of a slag paved roadway with no other source present. The resulting dose from slag is vanishingly small. Assume the same person is confined to a basement constructed of concrete using slag at 43% by weight. The slag contribution will be approximately 25 uR/hr. If no shielding is available, a point in a corner, 1 m from each wall and 1 m above the floor will have the additive effect of 75 uR/hr. If the basement is 30 ft square, the other two walls will contribute an additional 8 uR/hr each for a total of 91 uR/hr. The annual dose from such an exposure would be nearly 800 mrem. The largest, measured indoor exposures are 37 uR/hr by Boothe (5) and 38 uR/hr by the EPA (3). Shielding by materials indoors apparently reduces the exposure or the concrete does not deliver the maximum possible exposure rate. Shielding by the floor, plus distance should reduce the exposure rate by one third on the first floor.

Dose Estimation

Dose estimation for populations and individuals requires knowledge of population density and activities and knowledge of the exposure situations. Knowledge of population density and activities is obtained from census records and records of employers, schools and commercial and recreational activity. Knowledge of exposure situations comes from systematic and rigorous measurements.
Measurements may be either specific or averages. Two examples of specific measurements are the exposure rates when driving on a slag-based roadway and the exposure rate associated with a known work activity. Either of these can be used to obtain good estimates of dose for the time exposed.

Most situations for a population must rely on average doses, since the activity is confined only to an average location. A good estimate of dose requires a good estimate of the average exposure rate. The average exposure rate must be determined by a systematic set of measurements, designed to fit the particular exposure situation.

A home is not properly surveyed by taking a single measurement on each floor. A set of measurements for each room should be taken, such as 1 m inside the door, the center of the room and 1 m from the center of the north wall. A similar system should be developed for other exposure situations. Measurements taken at the discretion of the investigator tend to follow the bias of the investigator, i.e., the highest or lowest reading found. It should be obvious from the geometry of the exposure situations that only a systematic approach will provide a good estimate. There was no demonstrated systematic approach used in the Idaho Radionuclide Study (3).

The systematic approach should include techniques to determine background for the location surveyed. A region that has elevation changes of 100 ft or greater and various rock and soil types will have local backgrounds that differ significantly. The use of an average background for the region could cause over or under estimations of the dose. Background can be determined by selecting locations sufficiently remote from sources and can be confirmed by demonstrating uniform exposure rate with distance from a source. Background can also be established by gamma ray spectral analysis.

Dose Estimation, Idaho Radionuclide Study

The Idaho Radionuclide Study relied on both aerial (6) and ground (3) measurements to determine the exposure situations of the populations and individuals. The aerial measurements were systematic, covering the entire populated area with the same density of measurements. The ground measurements were not systematic, relying on volunteer participants and an unequal number of measurements at the chosen locations. The aerial measurements over-estimate the average because of their wide field of view. The ground measurements do not estimate the average as no attempt was made to measure average locations, i.e., to systematically measure randomly selected locations. The report, nevertheless, attempts to reconcile the two types of measurements and uses the ground measurements as the standard. The measurements are compared as community and sector averages. The sectors were developed from a radial grid centered on the phosphorous plants. This type of grid is proper for air emission studies, but is cumbersome for distributed surface sources. A square grid is more appropriate, allowing equal areas for intercomparison, averaging, and allocation of measurement resources.

Measurements performed 1 m above the ground are the preferred method, however, aerial measurements allow rapid assessment of large areas if proper corrections are applied. Aerial measurements have a wide field of view, so the results are averaged over a large area. The averaging has the disadvantage that small discontinuous areas much higher than the average will not be identified and their contributions distributed over the averaging area. The averaging, then, will cause a reduction in the dose estimation for time spent in very high exposure, small areas, but an increase in the dose estimation for time spent in the much larger area. As will be shown, the techniques of the aerial measurements cause an over estimation of the average, thus, causing an even larger over estimation in the dose when dose is assessed for an average location than would have been expected if a true average were made. The EPA (3) and EG&G (6) reports discuss the under estimation of the local exposure rate of small, high exposure areas but do not discuss the over estimation of the exposure rate of the larger area.

The report justifies the use of the aerial survey data by comparison to the ground survey data without demonstrating that the ground survey data gives a true average. A proper comparison could have been made by selecting a single area and mapping the exposure rate of that area by a ground survey. Instead, the report compares the percent aerial measurements by exposure rate range which were systematically obtained to percent by range of ground measurements which have no systematic basis.

Exposure Rate Range (uR/hr)	Percent of Measurements at Given Exposure Rates	
	Aerial	Ground
<9	0	0
9-11	0	5
11.1-14.5	36	41
14.6-17	36	29
18-22	23	12
23-30	5	4
31-50	0	3
51-100	0	6

The aerial measurements show that 64% of the measurements were above 14.5 uR/hr while only 54% of the ground measurements were above that value even though the ground measurements recorded the highest values. The aerial measurements, also showed no values below 11.1 uR/hr. These differences show that the aerial measurements tend to indicate a higher average over large areas. The average for the ground measurements was, nevertheless, higher than the aerial measurements. This difference results from the lack of assigning a weight to each ground measurement based on the percent of area at that exposure rate level. A weighted area assignment would not be necessary if a sufficient number of measurements were made on a systematic basis. The table does not establish a correlation between aerial and ground measurements, since a basis for comparison was not established.

A correlation was assumed, nevertheless, as a basis to correct the aerial measurements to the ground measurements. An area weighted average of 18.6 uR/hr for Pocatello was obtained for the aerial measurements. The average is the EG&G best estimate of the true average since it is corrected for air exposure response, 1 m above ground, including 5.4 uR/hr of cosmic radiation. The conversion to 1 m above ground is

$$EX = A \times B + 5.4.$$

Where EX is the exposure rate, A is the conversion factor, and B is the base measurement. The Idaho Radionuclide Study converts this value to conform to their ground average by dividing by .93, the aerial to ground ratio. This new value is then converted to exposure rate using the conversion factor for their detectors of 0.582 and 4.9 uR/hr of cosmic added to equal 16.6 uR/hr. This conversion lowers the average, but the effect is to convert the above formula to

$$EX' = A' \times B + 8.28.$$

This new exposure is obtained with an unvalidated conversion factor and the addition of 8.28 uR/hr of cosmic. The cosmic value is obviously incorrect. (The difference between 5.4 and 4.9 is the result of the altitude of the aerial detectors.) The correction should have been to subtract 5.4 from the first formula, then use the conversion factor, A', and finally add 4.9. The result is then an exposure of 13.2 uR/hr. This value may be nearer the correct value, but uses an unvalidated conversion factor. The proper approach is to examine the method by which the aerial measurements average small areas and to apply the conversion factors developed by EG&G.

The EG&G report states that an area with an equivalent diameter of 50 m will average over an area 200 to 300 m in diameter and thus the average exposure rate will be an under estimate for the small area by 6.5. This under estimation is not a simple ratio of the areas since the area of a 50 m circle is only 4% of a 250 m circle. The lack of correspondence to a simple ratio of the areas results in an over estimation of the exposure rate of the larger area. A roadway can be used as an example of how this over estimation occurs. A roadway, 10 m wide, that crosses the aerial detector field of view of 250 m diameter has an equivalent diameter that results in a area that is 5% of the averaging area or an under estimation of the roadway exposure rate by less than 6.5. (Recent ground-based measurements by the author showed the number to be between 5 and 6.) The aerial measurements are obtained by flying parallel paths 76 m (250 ft) apart and 46 m (150 ft) above the ground. The roadway from these distances and resulting angles can be considered a line source so the exposure rate decreases as the inverse of the distance and the cosine of the angle from the normal. A detector that is directly above the roadway centerline is 46 m from the source, while a detector that is laterally displaced 100 m is 110 m from the source. See Figure 1. The ratio of these distances is 2.4 so the distant measurement is only 2.6 times smaller if the angular effect is included. The viewed area of the roadway when the center of the field of view is laterally displaced 100 m is 3% so that the measurement should actually be 4.4 times smaller. Ground-based measurements taken 1 m above the source and at a 1 m height 100 m from the boundary of the source would differ by at least 10,000 if the inverse distance plus cosine of the angle decrease holds for ground-based measurements. Figure 2 shows cross sections of measurement results taken aerially and ground-based. The areas under the curves in units of exposure rate per area are aerial, 933 and ground-based 377. The inverse distance-cosine decrease estimates an even smaller area than measured. The aerial measurements over estimate the average exposure rate for a large area by 2.5 in the case of a roadway. Parallel roadways 50 m apart or parking lots present opportunities for even larger over estimations.

It appears that a more appropriate method for correcting the aerial measurements is to divide the difference from background by at least 2.5. The problem now is to determine the correct background. The EPA chose 12 uR/hr as the average and applied this value universally to all measurements. EG&G found that the background varied from 11 to 17 uR/hr in the Pocatello area, but did not estimate an average value. Should 12 uR/hr prove to be correct, then the net community average above background for Pocatello is nearer 2.6 uR/hr than the 4.6 reported by EPA. The correction factor of 2.5 is probably the lower bound and the average background most likely exceeds 12 uR/hr, so 2.6 is the upper bound for the net community average. A similar consideration for Soda Springs lowers the upper bound, net community average to 3.5 uR/hr.

The proper use of the aerial data appears to be as an excellent guide for performing detailed ground-based measurements. Small sets of detailed measurements in typical locations with detailed dose estimation would be beneficial in interpreting the risk posed by using slag as a surfacing and construction material.

Indoor measurements performed by the EPA for purposes of dose estimation do not require conversion since they were obtained using pressurized ionization chambers, which if properly calibrated display directly in uR/hr. Three possible problem areas are not eliminated by the description in the report that could make the data non-representative of the net indoor exposure rate. The first is that the house selection was done on a voluntary basis. No information was provided to ascertain if the percentage of homes surveyed or percentage by sector was sufficient to be representative. The second problem area is that there was no obvious system to obtain average exposure rates in each home. If only single measurements were made per floor, then the bias of the investigator probably prevailed. The most serious problem area is that no attempt was made to establish the background of each home. An assumed background was used for all homes irrespective of their location or building materials. Background outside the home should have been established, net radiation levels due to nearby slag at the surface of the home should have been measured, and gamma ray ratios inside the home could have estimated net radiation due slag.

Absent any indication that radiation levels inside homes may have included contributions from slag, all levels in homes should be considered background.

Risk Estimation, Idaho Radionuclide Study

Risk was estimated in the Idaho Radionuclide Study using the common practice of linear extrapolation from high doses and no threshold effect. The practice arrives at a conservative, upperbound estimate to which a level of acceptable risk is usually applied. No level of acceptable risk was given in this study. The risk estimate used doses developed from the exposure rates determined by the methods described above and applied them to the population based on locally available data concerning population distribution and activity. Workplace exposures, which were not specifically developed, were assumed to correspond to home environments for indoor workers and the average outdoor exposures per sector for outdoor occupations.

The dose estimates were based on the total population and an assumed distribution within the community for exposure rates and time spent in average locations. The indoor exposures, both for home and work environs have not been verified, the outdoor exposures are over estimated by at least 2, and the driveway exposures are suspect because a systematic measurement scheme was not indicated. Further, since this activity was intended to include time while driving a shielding factor should have been included. Assuming that half the driveway time was for driving where a 40% shielding factor applies then half this dose is reduced by 40%. The report in Tables 11-17 and 19 estimates for Pocatello that the average individual receives 14 net mrem per year from phosphate slag. These tables should be adjusted based on zero net exposure in indoor environments, and a factor of 2 decrease for outside exposure rates and the above adjustment for driveway exposures. The result is 5 mrem net average individual dose per year. A similar exercise for Soda Springs using Tables 4-10 and 18 results in 40 mrem net average individual dose per year as compared to 52 in the report. This new estimate includes a percentage adjustment to the indoor exposure in the same relative amount as Pocatello.

Alternative Dose Assessment

An alternative dose assessment should be considered since the EPA report relied on non-systematic measurements and an improper conversion of the aerial data. This new assessment must be general and approximate since little hard data are used.

Two extreme exposure situations were proposed earlier in this report for persons confined full-time indoors. The situations resulted in annual doses of zero and 800 mrem. The latter value is a mathematical construct not supported by measurements. Published results indicate that the upper bound should be based on 38 uR/hr or 333 mrem/yr.

Another maximum exposure situation is exposure from asphalt containing slag. Asphalt containing slag ranged as high as 28 uR/hr above background in recent, ground-based measurements. Full-time residence above this exposure rate would result in 245 mrem/yr. This is not a credible exposure situation, but does allow simple visualization of possible doses. A more credible dose is from full-time work exposure to asphalt containing slag which would result in 56 mrem for 2000 hrs exposure.

Recent measurements showed that the exposure rate from a broad source decreased rapidly with distance from the boundary of the source. The excess exposure rate decreases to zero in 10 m. Most residences and businesses are located 10 m or more from roadways so the net effect from the roadway is zero exposure. The structures effect an additional reduction of 50% of the exposure so that any additional radiation from landscaping or driveway materials are essentially zero within the structures. There are no verified homes in Pocatello built with slag-based concrete so all net indoor exposures are assumed zero.

The largest exposure rates are experienced above thick layers of crushed slag used for gravel surfacing, fill, or ballast. Thick layers of slag used in railroad and truck yards produced net exposure rates of 45 uR/hr. A worker exposed to this exposure level for 2000 hr per year would receive a dose of 90 mrem/yr.

Other exposure situations are

1. 1 hr per day driving on slag-based roadways. The automobile effects a 40% shield of the radiation so a person would receive 6 mrem/yr from a roadway of 28 uR/hr.

2. 4 hr/wk in outdoor activities for adults at an average exposure rate of 14 uR/hr from driveway and landscaping materials. The dose from these activities is 2.9 mrem/yr.

3. 15 hr/wk in outdoor activities for children and teens at an average exposure rate of 2 uR/hr. The dose is 1.6 mrem.

4. Outdoor and community activities for adults 10 hr/wk at 2 uR/h for 1 mrem.

5. Outdoor workers, 2000 hr, 2 uR/hr for 4 mrem/yr.

All other exposure situations are assumed zero, as for the indoor exposures. The doses for the activities include the occupancy factors so total population dose can be assessed by the percent of the population experiencing each exposure situation. The population exposure assumptions are as follows 3% receive 90 mrem/yr, 3% receive 56 mrem/yr, 15% receive 6 mrem/yr, 11% receive 4 mrem/yr, 40% receive 2.9 mrem/yr, 50% receive 1.6 mrem/yr, and 50% receive 1.0 mrem/yr. The average annual population dose is 8 mrem. It should be obvious that a person could be subject to several exposure situations and that hours of zero net exposure were not included. The population exposure percentages were based on the EPA estimates. This estimate is less than the original EPA estimate, but more than the revised EPA estimate of this report. The major increase over the revised EPA estimate is more worker exposure. Since this estimate contains maximum credible exposures for workers rather than average exposures it should be considered the upper bound for the revised EPA estimate.

The maximally exposed individual is a worker over crushed slag, who drives 1 hr/day over slag pavements, is exposed to driveway and landscaping materials, and community exposure. This individual would receive 100 mrem/yr for half of a 70 year life, assuming the individual worked at this occupation for 35 years. The remaining half of the worker's live would be at a maximum average exposure of 8 mrem. The highly unlikely maximally exposed individual from confinement in a basement who could receive up to 333 mrem/yr from 38 uR/hr would be even more unlikely to be exposed for 70 years.

Risk Estimation

Risk estimation is the practice of determining the statistical probability of the occurrence of an event of risk based on known or estimated dose response mechanisms. Risk is estimated to either individuals or populations. Individual risk is the calculated response of an individual to a stimulus based on the average response of a population to that stimulus. The proportionate response and the range of validity of the proportionate response must be known or assumed, e.g., doubling the dose, quadruples the response between the limits A and B. The extension of the risk estimate to populations is valid since the average response was determined from a population response, e.g., the risk of occurrence to two individuals is twice the risk to one individual if both received the same stimulus.

Human risk from external gamma radiation dose has been determined from acute radiation exposures. No hard cancer effects have been observed below 50 rem and no leukemia effects below 10 rem. No other health related effects have been observed below 10 rem.

Animal and human data show that protracted exposures reduce the risks by, at least, 2 and protracted doses near background levels and rates reduce the risks by 10. Common practice in risk estimation is to conservatively extend the estimates to below the lower validity level and not to apply a dose rate effect or DREF. A level of acceptable risk is then usually established to justify lack of action below a given level of risk. Population dose is used to magnify the effect below the lower validity level. A small dose, regardless of dose rate, applied to a large population will raise the total population dose into the individual dose validity range. This does not validate the population dose.

Risk calculation, as currently practiced, is simply the application of a linear estimate of the probability of an event per rem of dose. The risk factor is a conservative, linear extrapolation from acute, high-dose data. Extrapolations below the limit of validity are hypothetical and are not supported by scientific evidence. The limit of validity is 10 rem. The formula for calculating risk for cancer death is

$$R \times 10^{-4} \times X \text{ rem/yr} \times Y \text{ yr} \times Z \text{ persons}$$

where R = 1.2 -1.6 BEIR III (7)
4.0 EPA, this study
7.7 BEIR V (8),

Y = 70 years for life-time risk or 1 for annual population risk,
and Z = 57,000 for Pocatello for population risk.

The result is cancer deaths per year for the population or the individual probability of death by cancer.

The calculated risks following this practice are compared for various dose estimates and risk factors. The EPA in the Idaho Radionuclide Study used R = 4 and the average individual dose of 14 mrem/yr. Their population risk estimate was then

EPA population risk = 0.3 cancer deaths/yr

EPA individual life-time risk = 0.0004

A dose rate effectiveness factor of 2 lowers these two estimates by 2.

EPA DREF adjusted population risk = 0.15 cancer deaths/yr

EPA DREF adjusted individual life-time risk = 0.0002

The revised EPA dose estimate of this report reduces the average individual annual dose to 6 mrem. This revision and DREF adjustment lowers the risk estimate by more than a factor of 4.

> EPA revised dose and DREF adjusted population risk = 0.07 cancer deaths/yr
>
> EPA revised individual dose and DREF adjusted individual lifetime risk = 0.00008.
>
> The BEIR V (8) suggested but did not recommend a DREF of 10 for low dose and low dose rate situations. This DREF would clearly place these doses in the non-hazardous range of 1 chance in 1,000,000. The BEIR V risk factor of 7.7 would not appreciably raise the risk estimate for a DREF of 10.

Discussion

There is no question that exposure in these communities has increased as the result of the use of slag for construction purposes. There is a question as to whether the dose is as high as is estimated by the EPA, since proper subtraction of background and interpretation of the aerial and ground-based measurements is suspect. A question must also be raised concerning the risk estimates and especially an interpretation of the risk estimates. Better ground-based measurements could define limits and need for action in specific cases. The information to date does not indicate a risk that would require immediate action or preclude careful, purposeful measurements before decisions concerning such actions are made.

The conservative practice of risk assessment does not take into account the difference between the effects of acute, high dose radiation and protracted, low dose radiation, but extrapolates the acute, high dose effects linearly to zero. The calculational model then used to predict dose effects fits the extrapolation to within 25%, yet there is no certainty that the extrapolation is correct to zero. There is considerable evidence that the lower limit of validity may be 10 rem since no health effects are seen below this level. The doses estimated in this study will most likely, therefore, have zero health effect on the communities exposed to radiation from slag. The highest hypothetical dose of 800 mrem is more than 10 times lower than the lower limit of observed health effects.

The risk to the populations of Pocatello and Soda Springs is negligible and most likely zero. Actions to reduce exposures from construction and surfacing materials are not warranted.

Discontinuation of their use is not recommended, especially if other materials increase the risk to the population through transport and mining risks. Other social and economic benefits should be considered before discontinuation is recommended. The conclusion in NCRP 93 should be heeded, that dose reduction "... would not be feasible or cost effective in the case of building materials or mining and agricultural products."

References

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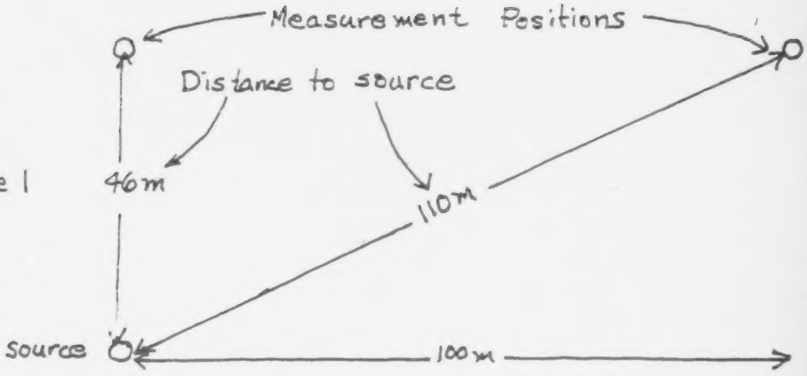
8. National Research Council, Committee on the Biological Effects of Ionizing Radiations (BEIR V). Health Effects of Exposure to Low Levels of Ionizing Radiation. Washington, D.C. National Academy Press, 1990.

Figure 1


Measurement Positions
Distance to source
46m
110m
source
100m

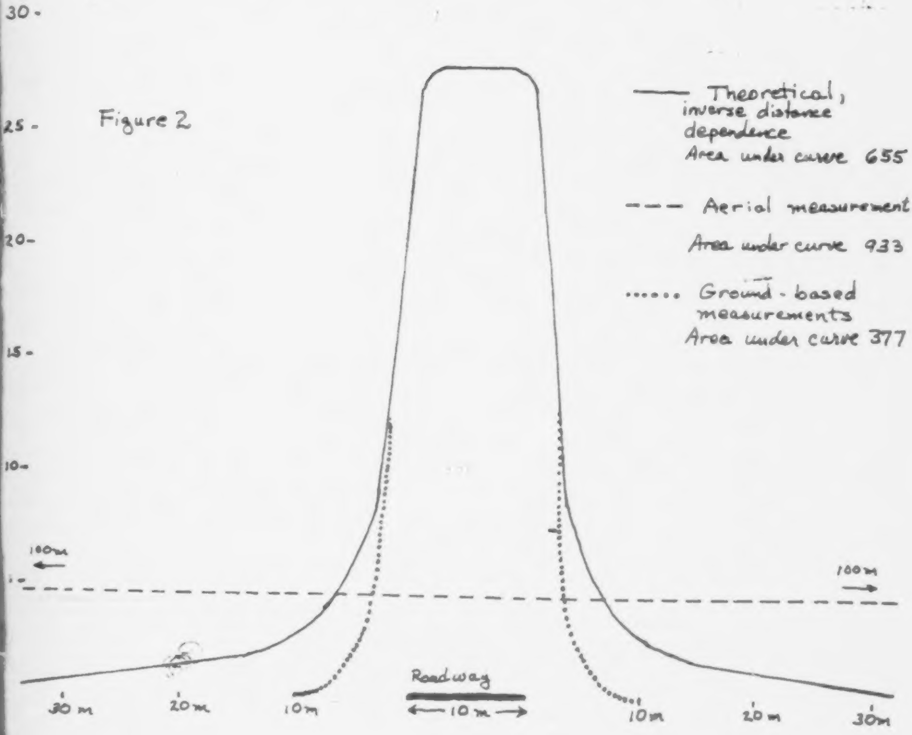


Figure 2

30
25
20
15
10
1
—— Theoretical, inverse distance dependence
Area under curve 655
- - - Aerial measurement
Area under curve 933
...... Ground-based measurements
Area under curve 377
100m ←
100m →
Roadway
← 10 m →
30 m
20 m
10 m
10 m
20 m
30 m

036640 9 [illegible] 5:01

Senator Steve Symms
Washington, D.C.

Dear Senator Symms:

Thank you for sending us your announcement of a hearing to be held in Soda Springs, concerning the use of radioactive slag as gravel for construction, repair, and maintenance. We will not be able to attend the meeting, unfortunately, because we will be out of the state at that time; however, we are interested in your position concerning the issue and would like to make known to you the attitude that we have, as full-time residents of an Idaho city in which the slag has been used heavily for some time now.

You are aware of the reputation that Pocatello has, no doubt, as one of the dirtier cities in the Intermountain region. This is largely due to the two phosphate plants owned by FMC and J.R.Simplot. Whether the economic gains of the plants outweigh the environmental losses, or not, is a controversial matter and not really the point here at all, except to say that Pocatello certainly would benefit by any cleaning up that we can do, and that neither of the plants is in the primary business of producing slag fcr sale. We cannot understand your attitude, therefore, which seems to be that any financial gain to anybody, however slight and private that is, is worth any loss to the environmental health of the public as a whole. Who is most bothered by the EPA ruling that the use of slag provides a health risk, after all? Bannock Paving, a private construction firm, and perhaps FMC, if it counts its dimes and pennies that closely. Who gains by the change in policy that has happened? All of us who live in southeastern Idaho, whose health can be, however slightly, improved.

We attended the meeting in Pocatello when the representatives of the EPA(not at all a radical group, you know) presented their findings. We were well satisfied that they did their research well, that they are acting responsibly, and that they have a serious and legitimate point. We also were unimpressed by the foolish and half-baked arguments of those who criticized the EPA at that hearing. We cannot understand your insistent position of undermining their work and conclusions, just to help a private company make a better profit. Whatever the citizens of Soda Springs decide is up to them; but we want you to let the EPA do the work for Pocatello that they were established to do. The environment is becoming a very big issue politically, and by the time that you come up to the next election, you will very much want to be on the correct side of such matters as these.

Thanks, and sincerely yours

Dante and Judie Cantrill, 249 S. 7th
Pocatello, Idaho 83201

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Senate Subcommittee on the Environment and Public Works
Attention: Karen Spence
U.S. Senate Office Building
Washington D.C. 20510
FAX: 202-224-1273

Re: Written testimony relative to the hearing on the disposition of slag held in Soda Spings, Idaho on August 21, 1990.

The focus of the Senate Subcommittee hearing on slag is of regional importance, and as such, it is of concern to everyone who lives in Southeast Idaho. There are fewer than ten (10) phosphate processing plants in the United States. Many of those plants are in Southeast Idaho and yet regulation in Idaho is no more or less than in those states that have no connection with that industry.

The presence of slag in Southeast Idaho represents an insipient danger to its residents. A visitor can pass through and not be affected because of short term exposure. An adult moving here or an adult who had been exposed since the phosphate industry began in the 1940s will not be as susceptible to the effects of low grade radioactivity as a child who has grown up with its presence. Isn't it hypocritical to talk about the future of this nation being in the hands of its youth only to turn around and put that future into jeopardy?

There are many contaminants that we cannot remove by choice; but when we can, why not do it? EPA's studies are valid and reliable. As a researcher I am more impressed by studies done by outside agencies than by the producers who attest to the efficacy, safety, and/or usefulness of their commodities. Why? The built-in bias of such studies is central to the results: data collection, level of significance, and accompanying conclusions do not necessarily represent the best use of scientific procedure.

Emotional appeals made by individuals, regardless of their national stature, that do not address the issue but instead speak to arousing public sentiment also interfere with public understanding of the issues. The obfuscatory nature of these appeals may fool some individuals, but those who are willing to look at the facts will nto be offput by them.

Slag is radioactive. It creates a problem for those who must live in proximity to it. Why put citizens at risk if unnecessary--especially if those citizens are the youth we so carefully nurture to adulthood? The commercial disposition and value of slag is minimal. It does not provide an economic boon for Southeast Idaho. As a waste product it must be dealt with in a manner that does not endanger residents any more than necessary. If that disposition of waste is a part of production

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costs in all other inducstries, then why not in the phosphate industry?

I would have come to the hearing to speak, but am not interested in being harassed by those people who have an emotional investment in preserving the status quo in Idaho.

Thank you for your time,

Kathryn C. Merriam, Ph.D.
4780 Clearview Ave.
Pocatello, Idaho 83204

ARCHIE W. SERVICE, ESQ.
7050 RUNNING IRON LANE
POCATELLO, IDAHO 83204

036661

AUG 17 5:59

Steve Symms U.S.S.
United States Senate
Washington, D. C. 20510-1202

Dear Senator Symms:

We are in receipt of your letter of August 10, 1990, concerning the "SLAG" issue and the EPA. Since we have out of state commitments we will not be able to attend the Soda Springs meeting.

However, a few years ago, when I was chairman of the Idaho State Board of Health and Welfare, which, though the Department of Health and Welfare, had state interest in this very issue, the EPA and the state examined this very question. It was the conclusion then that the slag had no substantial health risk to public health. I do not have the specific data in my personal file to verify this at this time but this is my distinct recollection.

Thus, it would seem to me that it would be in the public and Idaho interest to see what substantial changes in scientific data have transpired from that date to this.

My experience with the EPA officials in this region was one of reason and communication. My thought would be to closely examine what changes in scientific data, if any, have occurred. We would recommend that the issue be reexamined to see if a rational modification of the present view would be appropriate.

Sincerely,

Archie W. Service

September 2, 1990

Roger Turner
307 N. Buchanan Ave.
Pocatello, ID 83204

Hearing Officer
Senate Sub-Committee
Hearing on the Idaho
Radionuclide Study

Dear Sirs:

I am writing to indicate my support of the conclusions made by the U.S. EPA in the recently released Idaho Radionuclide Study.

The Science Advisory Board (SAB) of the EPA was involved in the design of the study. The Health Physicist from the Health Science Section of the Department of Public Health Service has concluded that: "The solid waste produced in these processes (phosphate ore processing plants) contain concentrations of radioactive materials at levels that can be considered hazardous to human health under the appropriate conditions."

Why object to the conclusions drawn by the EPA? After all, there are plenty of alternate sources of gravel in S.E. Idaho, and since human health is on the line, lets not take any needless risks!!

The EPA, with U.S. Senate support, should immediately begin taking steps to regulate the transport of slag off-site of these phosphate industries, and initiate controls on them to prevent the release of slag into the environment (via the air or water pathways) to protect human health.

It's easy to take pot-shots at studies where the risks of low-level radiation are involved, but historically scientific studies have supported the conclusion to limit human exposure to low-level radiation. We should not error on the side which may increase cancer to our population, especially when alternate resources are so readily available which would prevent the exposure.

Thank-you for this opportunity to comment on the Idaho Radionuclide Study.

Respectfully yours,

Roger Turner

Mike Wade
9115 West Cinnamon Ridge
Pocatello Id. 83204

Karen Spence
US Senate Office Build.
Washington D.C.
20510

Dear Madam or Sir:

I feel strongly that slag should be regulated and the public protected as prescribed in your study. I'm sorry I couldn't be at the Soda Springs meeting but I had to work out of town and couldn't take time off. I would like to see slag used only in railbeds and in intercity highways if it must be used at all. I object to it's use even incapsulated within ur ban areas.

I am absolutely opposed to it's use in loose form as a road material.

If the Railroad and state are allowed to use it I will continue to protest the dust that Bannock Paving emitts constantly from the crushing opperation in Pocatello. Somthing must be done to control the dust. I'll bet even if the dust was safe, it would still be excessive. I lived (we just moved in August) down wind about three miles from the crushing, loading operation, and in the spring we go out and walk on our lawn and puffs of gray dust are emmitted at each foot fall. My summer car that is parked out in front of my house all winter and not used has it's black naugahide covered with gray and sparkily dust.

A contributing and serious problem is what they do about railcar loads of slag be fore it leaves the Bannock Paving area. The cars are pulled through a watefall and the dust that is rinsed off is then just left to sit on the ground to later, when it dries out, blow away.

The Railroad rinsed trains before in the yard that left a real dust problem that they later had to clean up. I would like the EPA to monitor this practice to make sure we are proteced.

I support your efforts 100% and again am sorry I could n't attend the Aug. 21 meeting in Soda Springs.
If you ever need a witness or if I can help in any way please contact me.

Yours truly

Mike Wade

P.S. I've seen roads made of loose slag turn to a fine powder after moderate auto traffic.